FAO Fisheries Technical Paper No. 189 FIIT/T189 (E)

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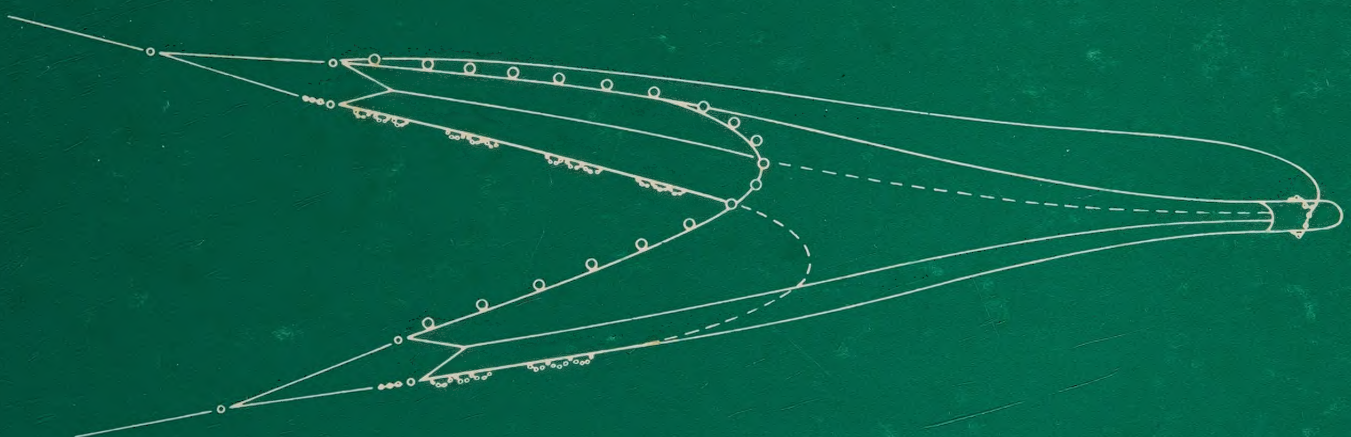
BOTTOM TRAWLS FOR SMALL-SCALE FISHING



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

BOTTOM TRAWLS FOR SMALL-SCALE FISHING

by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome 1979

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ISBN 92-5-100582-6

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PREPARATION OF THIS PAPER

This paper contains the designs of high opening bottom trawls which could be suitable for 50–180 hp small-scale fishing trawlers operating in coastal waters and large lakes. All necessary information for the construction of these trawls as well as for the preparation and adjustment of their rigging is supplied.

This information is especially intended for small-scale fisheries skippers, and skipper-owners, and fishing net makers. Fishery officers, technicians, instructors, extension workers, especially in developing countries, are also likely to be interested.

Distribution:

FAO Fisheries Department
FAO Regional Fishery Officers
FAO Field Fishery Projects
Fisheries Training and Extension Agencies
Small-scale Fisheries Skipper-Owners
and Net Makers

Bibliographic Reference:

Brabant, J.C. and Médélec, C. (1979)
FAO Fish.Tech.Pap., (189):40 p.
Bottom trawls for small-scale fishing

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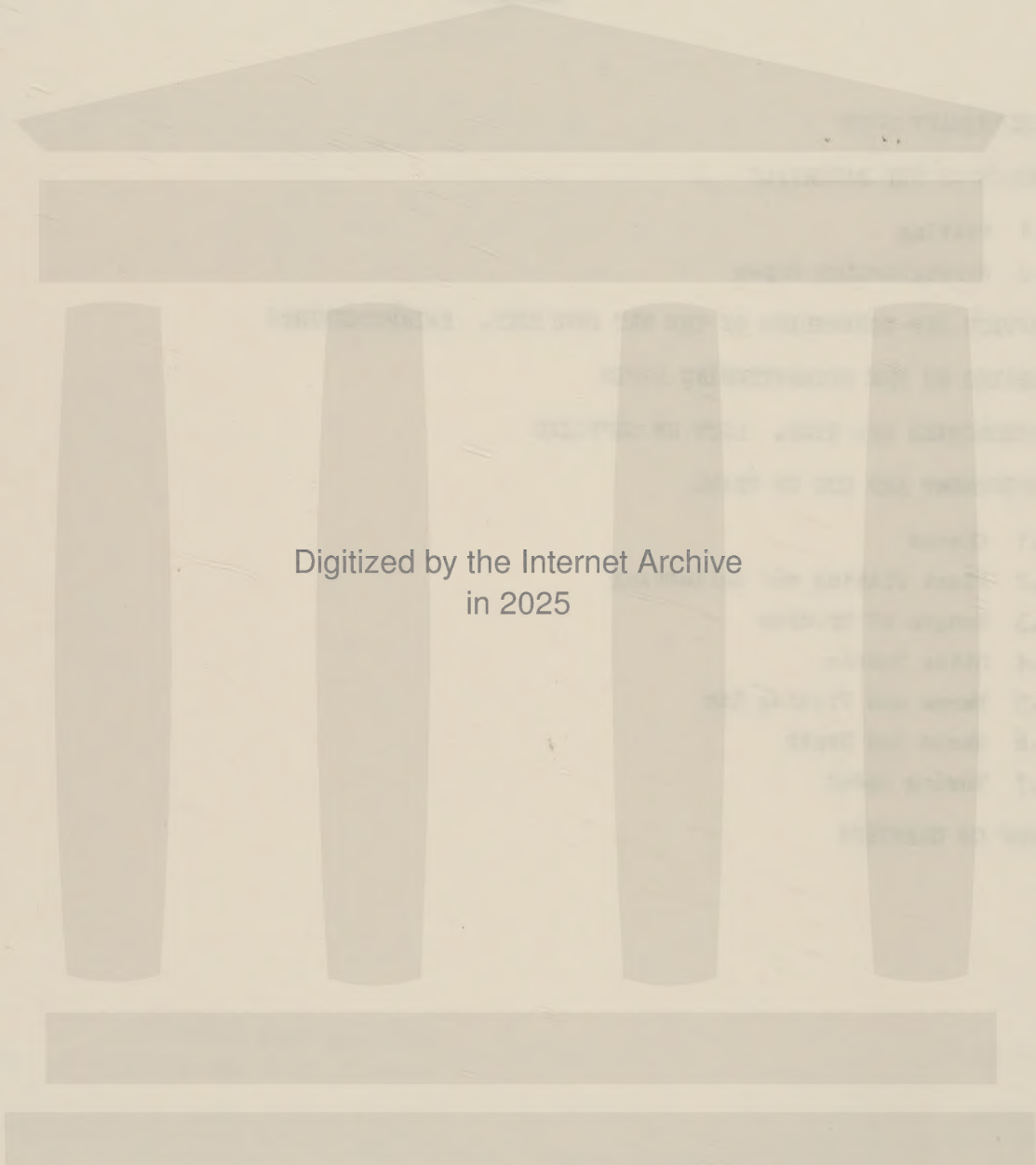

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1. PRELIMINARY NOTE

The trawls presented in this document were chosen for the following reasons: simple construction, easy use and adjustment, efficiency proven in commercial fishery. This gear is especially suitable for 50–180 hp small-scale fishing trawlers, operating in coastal waters or large lakes. Although especially suited to even grounds, they can nevertheless, with a suitable rigging adjustment, be used on relatively rough, uneven grounds.

The nets described are all for 2-panel asymetrical, high opening bottom trawls. Depending on the species sought, the user's choice will be made from the three following types:

Type A: Longwinged trawl, with small mesh in the front part and two-bridle rigging, especially suitable for fishing shrimp and small demersal fish

Type B: Longwinged trawl, with medium-size mesh in the front part and a two-bridle rigging, suitable for fishing demersal fish

Type C: Shortwinged trawl, with large mesh in the front part and three-bridle rigging, especially suitable for fishing pelagic fish, but also suitable for catching demersal fish

Three different sizes of trawls, with their appropriate otter boards and rigging, are suggested for each of these types for the following power ranges: 50–75 hp, 100–120 hp and 150–180 hp.

The mode of presentation of the drawings (trawl and otter board designs, accessories and riggings diagrams) is the same as that already used for the FAO Fishing Gear Catalogues. Please refer to these documents, particularly for information regarding the scales, units, abbreviations and symbols used.

The mesh size of the codends shown on the drawing, i.e. 40 mm in stretched dimension[1/], corresponds to an average which could be used both for shrimp and for medium and small species of fish. Alternative codends with different mesh sizes are also suggested, either for catching small-sized pelagic fishes (30 mm mesh size) or for larger sized species (60 mm mesh size) (see Drawing No. 13). On this subject, it must be stressed that the choice of the mesh size must be made with a view to respecting the regulations in force in the country concerned, which could require codends with a mesh size larger than 60 mm[2/]. It is therefore strongly recommended that the user approach his national fisheries administration so as to determine the suitable mesh size of the codend before ordering the netting material required for their construction.

As regards the chapter concerning the adjustment of the trawls, the reader's attention is drawn to the fact that the information given in this paper must be taken as general principles, intended as a guide to the skipper when he begins to use the gear. It is obvious that only gradual adjustments, based on long practical experience and careful observation, will enable the optimum yield that is expected from these trawls to be achieved.

1/ All the mesh sizes shown on the drawings correspond to the length of the stretched mesh, i.e., double the length of the mesh side

2/ Mesh size regulations usually refer to the mesh opening which corresponds to a dimension slightly smaller than the length of the stretched mesh

2. CHOICE OF NET MATERIALS

2.1 Netting

As can be seen on the trawl drawings, nylon (PA: polyamide) is the material specified for the netting since, compared with other textiles, its thinness for equal yarn resistance offers the highest catch efficiency. Depending on the facility of supply, this netting may be made of twisted or braided yarns.

In any case, it is advisable to check the size of the meshes in the new netting after prolonged soaking (about 12 hours) of a sample of the net in water at ambient temperature. In fact, depending on the type of yarn and the treatment, certain types of netting can show notable shrinkage on soaking (or even, more rarely, lengthening), which must be taken into account when mounting it.

Alternative textile

In certain cases, especially for supply or economic reasons, it may be advantageous to replace nylon by polyethylene (PE). This material, although appreciably less resistant to breaking than nylon of equal diameter, presents the advantage of being cheaper, with, however, a satisfactory performance in fishing due to its light weight (polyethylene floats in water), its good resistance to abrasion and less tendency to become entangled or hooked. Good results could therefore be obtained by replacing the nylon yarn by a polyethylene yarn and this for an almost equal Rtex or slightly higher (or for a runnage in m/kg equal or slightly lower) as shown in the table of corresponding values below, given as an example[1/].

Nylon PA		Polyethylene PE	
Rtex	m/kg	Rtex	m/kg
625	1600	650	1540
910	1100	970	1030
1250	800	1250-1333	800-750
1666	600	1750	570
2000	500	2000-2100	500-475

To compensate for the buoyancy of polyethylene, trawls made with this textile should be slightly more ballasted, as compared with nylon nets, to ensure the same contact of the ground-rope with the bottom. For the same reason, these nets will require fewer floats to obtain the same opening height as with nylon. Moreover, it must be remembered that for the same Rtex or m/kg, the polyethylene yarns will be slightly thicker than the nylon ones; consequently, their drag will be slightly increased and their towing speed slightly reduced.

2.2 Strengthening Ropes

The materials and diameters shown on the drawings for the strengthening ropes are for information only. If necessary, depending on the rope available on the market, these specifications may be modified, provided that the breaking strength[2/] and abrasion characteristics, as well as its satisfactory hold of hitches are respected.

1/ For more details on the characteristics of textiles, consult the FAO Catalogue of small-scale fishing gear (1975) or Netting materials for fishing nets (FAO Fishing Manual, 1973), published by Fishing News Books, 1 Long Garden Walk, Farnham, Surrey, England

2/ See FAO Catalogue of small-scale fishing gear (1975)

As for the netting mesh size, the length of the strengthening ropes will be checked preferably after prolonged soaking of the rope in water to detect any possible shrinkage on soaking which will have to be taken into account for mounting.

Depending on the weight in water of the material chosen for the strengthening ropes, ballasting and float fitting should be modified so as to avoid abnormal behaviour of the net on the bottom. For example, a net mounted on relatively heavy lines of combination rope will require less ballasting than the same net mounted on polypropylene ropes (PP, material floating in water).

3. CUTTING AND ASSEMBLING OF THE NET SECTIONS. REINFORCEMENTS

Cutting of the different sections forming the net must be carried out as economically as possible, reducing wastage from triangle and trapeze cut sections to a minimum. Drawings Nos. 15, 17 and 19 show examples of rational cutting of the component sections for the three types of trawl. Savings obtained in this way could be even more appreciable if several identical trawls are mass-produced. In this case, netting losses will be reduced to the strict minimum. If, to these savings, the obvious facilities of construction and repair are added, it will be seen how advantageous the standardization of trawl type can be.

The component sections of the net are assembled by means of seams along the longitudinal edges and by joins along the transversal edges (Drawing No. 22). These seams and joins are done according to current mending techniques. If necessary, specialized books on this subject may be consulted[1/].

From a practical point of view, for the joins, it is advisable to use a coloured yarn somewhat stronger than that of the sections to be assembled. The purpose of the colour is to enable the different component sections to be recognized more easily, thus simplifying mounting and repair. Also, when the net is damaged, the use of a stronger yarn often results in the tears to be stopped in the joins and therefore mended more easily. As regards the seams, when there is no side line (in the case of type A or B trawls), they should be very strong and should also be made with a coloured yarn, taking a minimum of 2 or 3 meshes from each section. When large catches are likely, or in the case of frequent damages occurring, it is recommended to reinforce the seams of type A or B trawls by means of a nylon or polypropylene strengthening rope (diameter 8 or 10 mm), mounted tight-stretched the whole length of the trawl (i.e., of a length equal to that of the stretched net).

Reinforcements

Before assembly, the sections of the net will be reinforced at parts subjected to particularly great wear or strain. These reinforcing parts will be made of pieces of double braided netting, in the shape of a triangle or narrow strip, hand or machine made (see Drawing No. 20) and fitted in accordance with mending principles.

It must also be noted that the codend is reinforced by an external lifting bag which acts as a protection device against wear on the bottom and for hauling the codend full of fish aboard.

1/ See for example: Le ramendage des filets de pêche, by L. Libert and A. Maucorps (1968, published by ISTPM, BP 1049, 44037 Nantes Cedex, France), also translated into English under the title of "Mending of Fishing Nets" (FAO Fishing Manual, 1973), published by Fishing News Books

4. HANGING ON THE STRENGTHENING ROPES

Once cut, reinforced and assembled, the net sections are then hung on the ropes in accordance with the following general rules, shown on Drawings Nos. 21 and 22.

The wings are assembled stretched, with the webbing tightly stretched, both on the headline and groundrope (hanging ratio E = 1.00 to 1.05, depending on the degree of elasticity of the netting) [1].

The upper and lower bosoms are hung on lengths of rope equal to the product of the number of meshes multiplied by the mesh side length (or half stretched mesh), less 20%; that is, by forming rather closed diamond-shaped meshes (hanging ratio E = 0.40). At the ends of the bosoms, a few meshes are usually hung closely until they touch (pinched meshes) to reinforce this part of the net which is more directly subjected to towing pull.

The wing lines, located along the V-shaped cuts of the wingtips are assembled stretched, with the netting stretched normally (E = 1.00).

When a side line is used (as in the case of 3-bridle rigged, type C trawls), it is mounted in accordance with different hanging ratios depending on where it is located on the trawl, i.e., E = 0.93 on the top wing and square and E = 1.00 for the remainder of the trawl body and the codend. Moreover, it may be seen that the length of the free front part of the side line corresponds to 85% of the stretched length of the wingtips.

It must be noted that it is normal practice for the extremities of the headline and groundrope (and if necessary the front part of the side lines) to be extended into free ends of about 1 m in length. In this way, most of the tears which may be caused to the net by the shackles and swivels attached to these extremities are avoided.

5. ACCESSORIES AND RIGS. LIST OF SUPPLIES

The constuction drawings of the otter boards (Drawings Nos. 10 to 12) and the rigging diagrams (Drawings Nos. 23 to 28) supply all the necessary information for preparing the complete trawl rig, from the warps to the codline. With regard to the otter boards, the construction drawings are detailed enough to allow them to be made by a naval blacksmith or carpentry workshop with standard tooling. As regards the vessel itself, and in particular the layout of the deck for towing and gear handling, specialized documents on the subject may be consulted [2].

For rig accessories such as floats, sinkers or bridles, the specifications given on the diagrams correspond to the most currently used articles. If, for reasons of facility of supply, different articles are used, the replacement articles must present the same characteristics from an operational point of view. Thus, for the floats, balls of a different diameter from that indicated may be used, provided that the total buoyancy obtained is comparable to that of the reference floats. On the other hand, it must be checked that these floats withstand the pressure at the depth of the fishing grounds exploited.

List of supplies

When the time comes for placing orders for the material required for construction of the gear and preparation of the rig, it will be practical to draw up a list of supplies, as shown on the example below, grouping together all the components, namely: netting, yarns, ropes, cables, otter boards, floats, chains for ballast, shackles, swivels, etc. This list

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1/ The hanging ratio E is defined as per ISO international standard by the ratio: length of rope/length of stretched netting

2/ In particular see: Small-scale fishing trawlers (FAO Fisheries Technical Paper No. 188)

will also present the advantage of supplying accurate references which will be particularly useful in the case of repairs or total or partial replacement of the gear.

Moreover, at the time the order is placed, it will be useful to add to the list of basic articles, the spare materials necessary for repairing the net or for possible replacement. Usually, a pair of lower wings and a lower belly, in separate sections, plus a certain quantity of each type of netting and yarn for mending, assembling and mounting, as well as a certain number of spare accessories for the replacement of damaged or lost parts, such as floats, sinkers, shackles and swivels. In addition, for normal commercial fishery, it must be noted that in case of serious damage or loss, one or several completely mounted spare trawls and at least one pair of boards, as well as ropes and cables for changing mounting ropes, bridles, sweeplines and warps, should always be available either on board or onshore.

Example of list of supplies

Minimum quantities required for making a trawl and a complete rig.

Type B-3 trawl

(a) Netting

Items[a]	Yarn (PA) Rtex	Stretched Mesh Size (mm)	Approx. Weight (kg)	No. of Meshes[b] T x N
Top wings (2)	910	120	3.1	58.5 x 25.5 154.5 x 69.5
Lower wings (2)	1250	120	6.5	56.5 x 25.5 178.5 x 94.5
Square	910	120	1.4	210 x 25
Top belly I	910	120	0.9	185 x 19.5
Lower belly I	1250	120	1.3	185 x 19.5
Top belly II + Lower belly II	910	80	4.0	469.5 x 49.5
Top belly III + Lower belly III	910	60	6.4	474.5 x 99.5
Baitings (2)	910	40	5.4	421.5 x 129.5
Codend (2)	1250	40	6.9	226 x 200
Lifting bag	∅ 4	120	3.2	68 x 22

a/ See Drawings Nos. 6, 16 and 17

b/ No. of meshes widthwise (T) and lengthwise (N). The half-mesh less lengthwise corresponds to the joining row

(b) Yarns

- Yarn for making reinforcements (white, double)
- Yarn for mounting (white or coloured)
- Yarn for joins (coloured)
- Yarn for seams (white or coloured, double)
- Yarn for fastening floats, chains, etc. (white)

about 5 kg of each type.

PA Rtex 910 or 1250 for reinforcements, mounting and seams
Rtex 1666 for joins
Rtex 2500 (or ∅ 2.5 mm approx.) for fastenings

(c) Ropes

Items[a/]	Materials	Diameters (mm)	Quantities (m)
Headline	PP/COMB	14/12	28
Groundrope	PP/COMB	16/14	34
Wing lines	PA/PP	10	15
Side lines (optional)	PA	10	76
Codline	PA	12	5
Lifting strop	PA	18	5
Lazy line	PA/PE	18	42

a/ See Drawings Nos. 6, 22 and 23

(d) Otter boards (see Drawing No. 12)

Flat rectangular type — 1 pair
Wood and iron construction — (right and left)
Dimensions: 1.90 x 0.95 m
Weight: 135 kg approx.

(e) Accessories

Items[a/]	Materials	Diameters (mm)	Quantities
Floats	Plastic/Alu	200	x 11
Sinkers (chain)	Iron	6	30 kg
Adjustment chains	Iron	14 - 16	2 x 6 kg
Shackles	Steel	10-12/14-16	2/16
Swivels	Steel	10-12/14-16	2/4
Otter board shackles	Steel	18 - 20	4
Otter board swivels	Steel	18 - 20	2
G-hooks	Steel	20	4
Recessed links	Steel	20	2
Recessed links with additional link	Steel	20	2

a/ See Drawings Nos. 23, 24, 26 and 27

(f) Warps and fishing rig

Items[a/]	Materials	Diameters (mm)	Lengths (m)
Warps (2)	Steel 6 x 19	12	2 x 200-600[b/]
Pennants (2)	Steel 6 x 19	12	6
Back strops (4)	Steel/chain	12	10
Sweeplines	Combination (COMB)	18	2 x 20-70[b/]
Upper bridles (2)	Combination (COMB)	12	30
Lower bridles (2)	Combination (COMB)	16	28

a/ See Drawings Nos. 23, 24 and 26

b/ Depending on depth

6. ADJUSTMENT AND USE OF TRAWL

6.1 Checks

Before being used for the first time, the trawl and its rig must be carefully checked. This routine check, which is normally to be repeated at the beginning or during each fishing trip, should focus on the following points:

- float fitting (number and attachment of the floats to the headline)
- ballasting (weight and fastenings of the sinkers to the groundrope)

- length of bridles and sweeplines (comparison to detect any abnormal difference)
- otter boards (brackets adjustment, length of back strops, weight if necessary)
- tightening of shackles and free motion of swivels
- length of warps (comparison to show up any difference in length between the two cables, on initial marking or after having been used for a certain length of time)
- fastening of codline
- lifting strop looseness and length of lazyline.

When fishing, depending on the results obtained during the first hauls, which should preferably be short, the skipper of the trawler will adjust the fishing gear by modifying the parts likely to reset in accordance with the general principles below.

6.2 Float Fitting and Ballasting

Depending on the relative importance of flat fish, invertebrates or debris from the bottom in the catch, the number of floats and/or sinkers will be increased or reduced and their distribution modified, taking into account at the same time the degree of wear of the ballast chains. Depending on the nature of the bottom, the method of fastening the chains may be modified and if necessary wooden olives, a covered groundrope or a double groundrope may be used (see Drawing No. 29).

6.3 Length of Bridles

The bridle lengths shown on the rig diagrams were worked out to obtain optimum net operation. The use of bridles shorter than those suggested is to be avoided, because this would result in a considerable reduction in the opening height and a resulting drop in trawl efficiency.

The adjustment chain which links the lower bridle with the wing tip enables the relative length of the upper and lower bridles to be easily modified. This adjustment is particularly important since it modifies the scraping of the groundrope on the bottom and also influences the opening height to a certain extent. In practice, a shortening of the adjustment chain tends to lift the groundrope off the bottom and slightly increases the opening height; inversely, its lengthening causes increased scraping of the groundrope on the bottom and reduces the opening height appreciably (see Drawing No. 29).

In the case of 3-bridle rigs (type C trawls), the behaviour of the net may also be modified by adjusting the length of the intermediate bridles. Shortening tends to increase the trawl opening height and causes increased scraping of the groundrope. Inversely, lengthening results in reduced opening height and eases the scraping of the groundrope. However, this is a delicate operation due to the sensitivity of the intermediate bridle adjustment and the length variations should be between 10 and 20 cm maximum.

6.4 Otter Boards

After a few hauls, it is useful to check the work of the otter boards on the bottom. The degree of wear of the sole will show whether they are at the right attitude. The wear should show a slight outward heel, combined with a more or less pronounced tilt depending on the nature and profile of the bottom (Drawing No. 30). Generally speaking, it must be remembered that a too short warp length increases the otter board heel, while a too long warp length can cause the otter board to lean inward. With regard to the tilt, it is easy to adjust it by slightly modifying the difference in length of the back strops (under normal conditions the lower strop is a few centimetres longer than the upper one). Finally, the angle of attack of the board can be checked from the scratches on the lower surface of the sole (Drawing No.30)[1/].

1/ For general information the publication Otter board design and performance (FAO Fishing Manual, 1974) may be consulted

6.5 Warps and Fishing Rig

For the type of gear described here, optimum trawl operation is obtained with a wing towing pull angle of about 11° (Drawing No. 30). The spread between otter boards, which conditions the value of the pull angle, depends above all on the balance between the length of warp paid out (a), on the one hand, on the other, the length of the "fishing rig" (b); the latter value being defined by the combined lengths of the sweepline, bridle and half of the headline. Generally speaking, every effort will be made to maintain the warp/fishing rig ratio (a/b) between 4 and 5. These values usually correspond to the most satisfactory trawl operation. In very shallow water, it will sometimes be necessary to reduce the ratio to a minimum of 2.5 to 3. When the equipment is being adjusted, it must be remembered that, for a constant warp length, lengthening of the sweeplines causes an increase in the net opening height and emphasizes groundrope scraping. Inversely, shortening of the sweeplines causes a reduction in the opening height and the less pronounced lay of the groundrope.

6.6 Warps and Depth

Taking into consideration the curvature of the warps in the vertical plane, proportionally shorter cables will be paid out in deep water than in shallow water, in order to guarantee the most efficient otter board attitude. Practically speaking, the ratio between the length of warp paid out (a) and the depth (c) can vary considerably, as shown by the figures below, which are given for information only.

Depth[1/]	Ratio warps/depth (a/c)
Less than 20 m	8 to 10
20 to 50 m	5 to 8
50 to 100 m	4 to 5
100 to 150 m	3 to 4

In shallow water, it must be noted that the warp length must not be less than about 120 m so as to obtain a suitable horizontal opening and to prevent the gear from being too close to the propeller and the hull which are sources of eddies and vibrations which frighten the fish and tend to chase them away from the trawl opening.

If both the warps/depth and warps/fishing rig ratio values are to be respected, it will be necessary to adapt the sweepline length to the depth, the longest sweeplines being suitable for the deepest bottoms. The sweepline lengths shown on the rigging diagrams correspond to the following average depths:

Power (hp)	Sweeplines (m)	Depth (m)
50 to 75	20 to 30	20 to 50
100 to 120	20 to 50	20 to 75
150 to 180	20 to 70	20 to 100

6.7 Towing Speed

Another very important point concerning trawl operation is that the towing speed must be suited to the fish species that are being sought. For shrimp and small bottom fish species, a speed of 2.5 to 3 knots is sufficient. For medium-size bottom fish and for small pelagic species, approximately 3 knots should be reached. Finally, for medium-size pelagic fishes, it will be preferable to trawl at at least 3.5 knots.

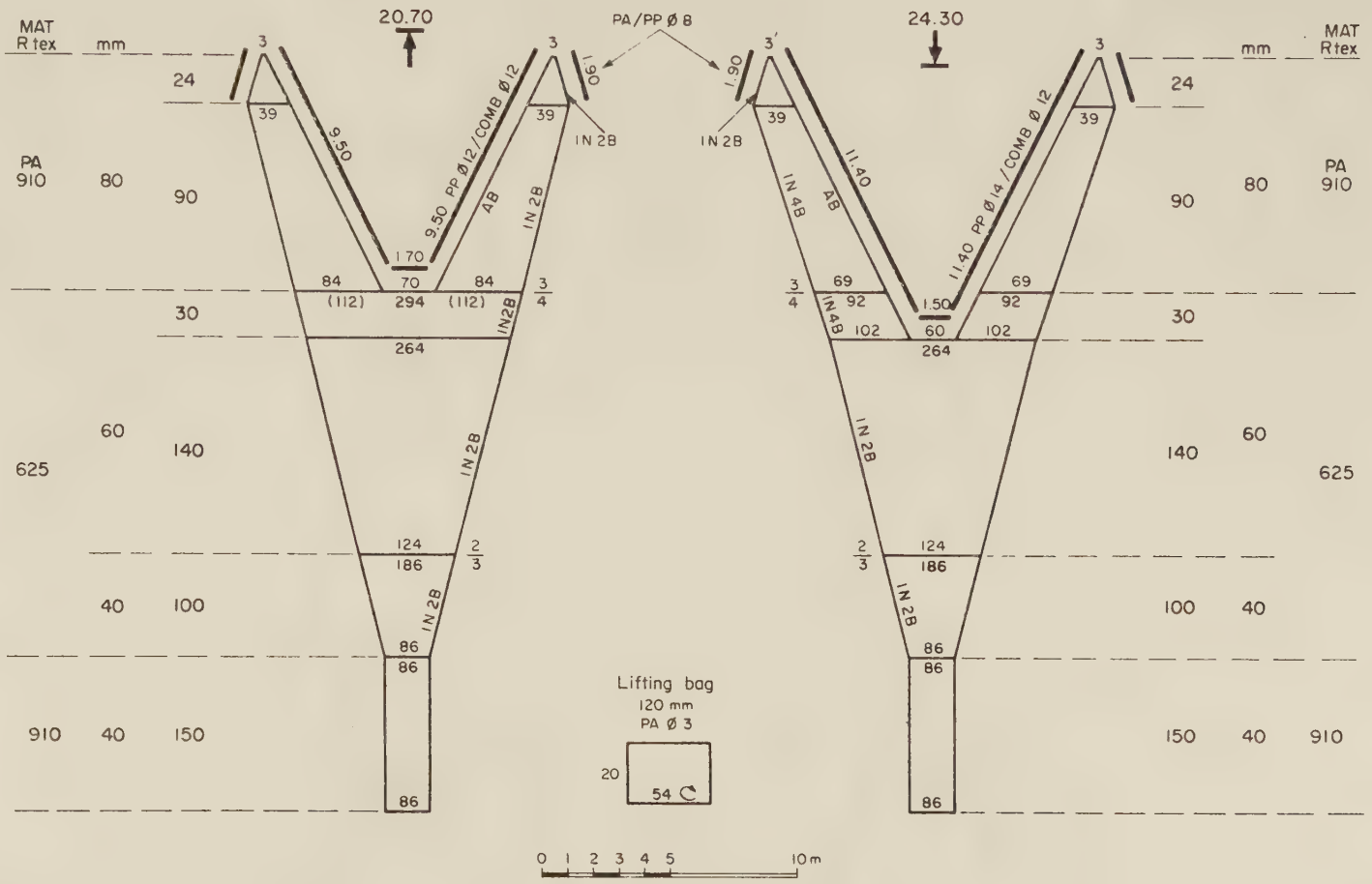
1/ If necessary, the user will have to take into account the regulations restricting trawling in shallow waters. This remark is also valid when trawling is prohibited up to a certain distance from the coast.

These speeds in fact correspond to the average values, and falling too far below them should be avoided. If, because of insufficient pull, it were impossible to obtain the recommended speeds, the size of the trawl and otter boards should be reduced to the size the next power category down. Moreover, it is recommended not to radically alter the yarn thicknesses specified on the drawings; use of too thick yarns in fact causes an important drag increase which results in a considerable drop in speed. Finally, towing at too high speed should be avoided, since this would result in the groundrope lifting off the bottom and opening height being decreased. Practically speaking, every effort should be made to respect the optimum towing speed depending on the type of trawl used, the species sought and the fishing ground conditions.

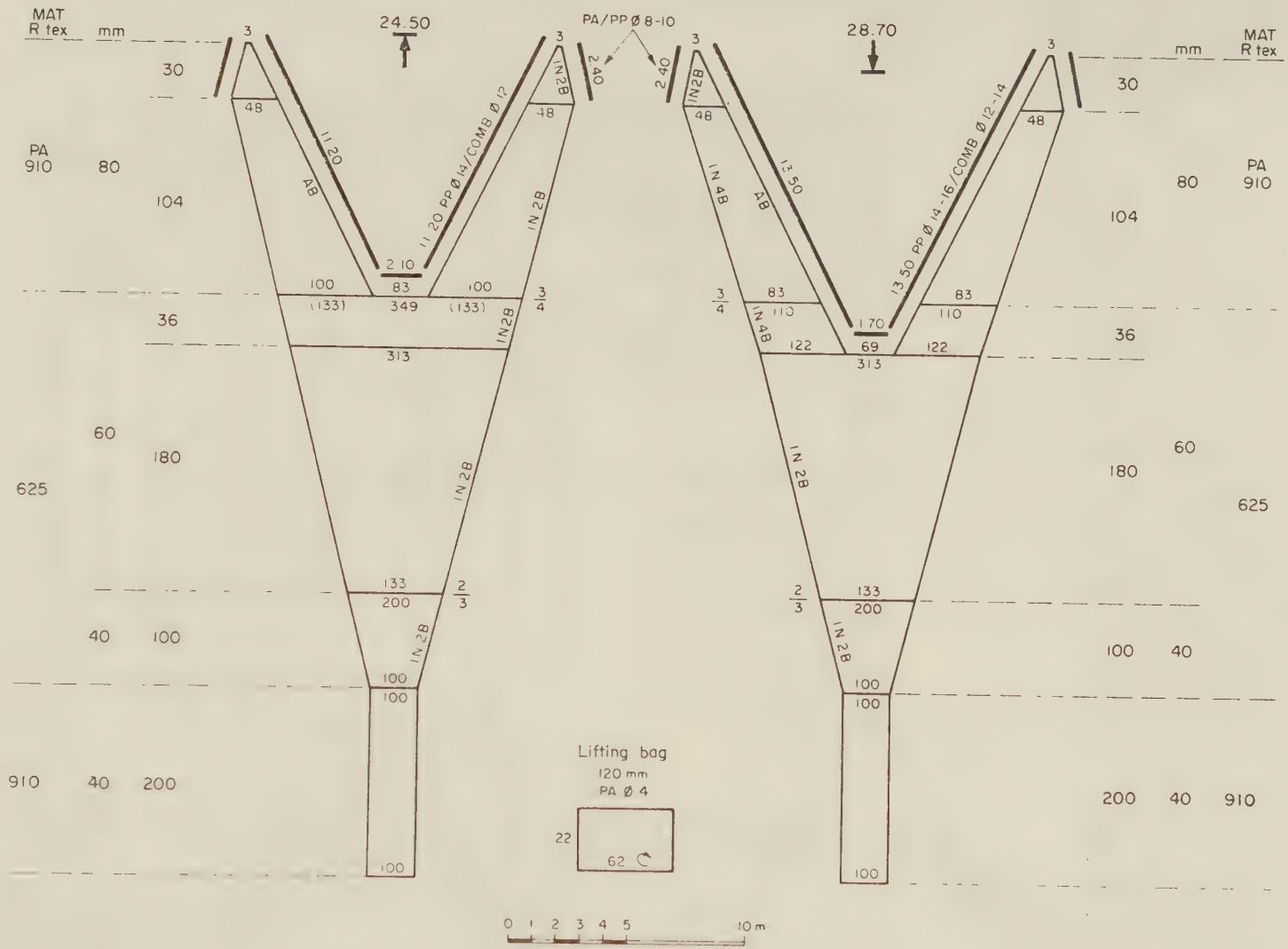
7. LIST OF DRAWINGS[1/]

Drawing No.		Type	Power (HP)
1	High opening bottom trawl - 528 meshes of 60 mm	A-1	50-75
2	High opening bottom trawl - 626 meshes of 60 mm	A-2	100-120
3	High opening bottom trawl - 744 meshes of 60 mm	A-3	150-180
4	High opening bottom trawl - 260 meshes of 120 mm	B-1	50-75
5	High opening bottom trawl - 310 meshes of 120 mm	B-2	100-120
6	High opening bottom trawl - 370 meshes of 120 mm	B-3	150-180
7	High opening bottom trawl - 196 meshes of 160 mm	C-1	50-75
8	High opening bottom trawl - 232 meshes of 160 mm	C-2	100-120
9	High opening bottom trawl - 276 meshes of 160 mm	C-3	150-180
10	Otter board	A-1,B-1,C-1	50-75
11	Otter board	A-2,B-2,C-2	100-120
12	Otter board	A-3,B-3,C-3	150-180
13	Alternative codends with modified mesh sizes	A-B-C	-
14	Designation of netting sections	A	-
15	Cutting of netting sections (Example)	A-3	-
16	Designation of netting sections	B	-
17	Cutting of netting sections (Example)	B-3	-
18	Designation of netting sections	C	-
19	Cutting of netting sections (Example)	C-3	-
20	Strengthening parts	A-B-C	-
21	Hanging on ropes	A-B-C	-
22	Assembling and mounting the trawl sections	A-B-C	-
23	Rigging the trawl - General arrangement	A-B-C	-
24	Rigging the trawl - I. With sweepline + 2 bridles	A-B	-
25	Rigging the trawl - II. With sweepline + 3 bridles	C	-
26	Rigging details for otter boards, sweeplines and bridles	A-B-C	-
27	Distribution of floats and ballast Examples (1)	A-B	-
28	Distribution of floats and ballast Examples (2)	C	-
29	Rigging adjustment I. Groundrope, sinkers and bridles	A-B-C	-
30	Rigging adjustment II. Otter boards, warps and fishing rig	A-B-C	-

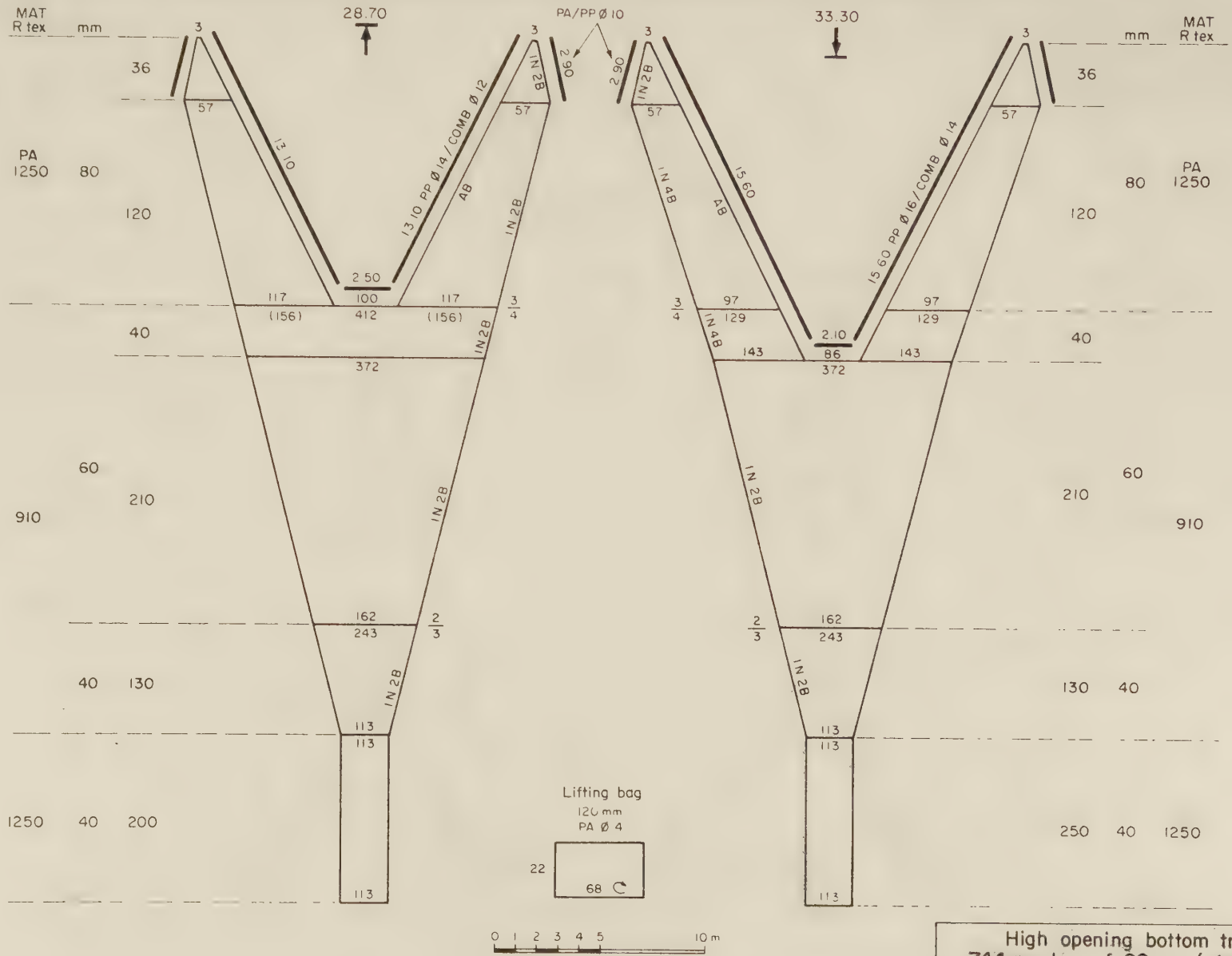
1/ Prepared by Mr. M. Carlesi, draftsman, FAO Fisheries Department

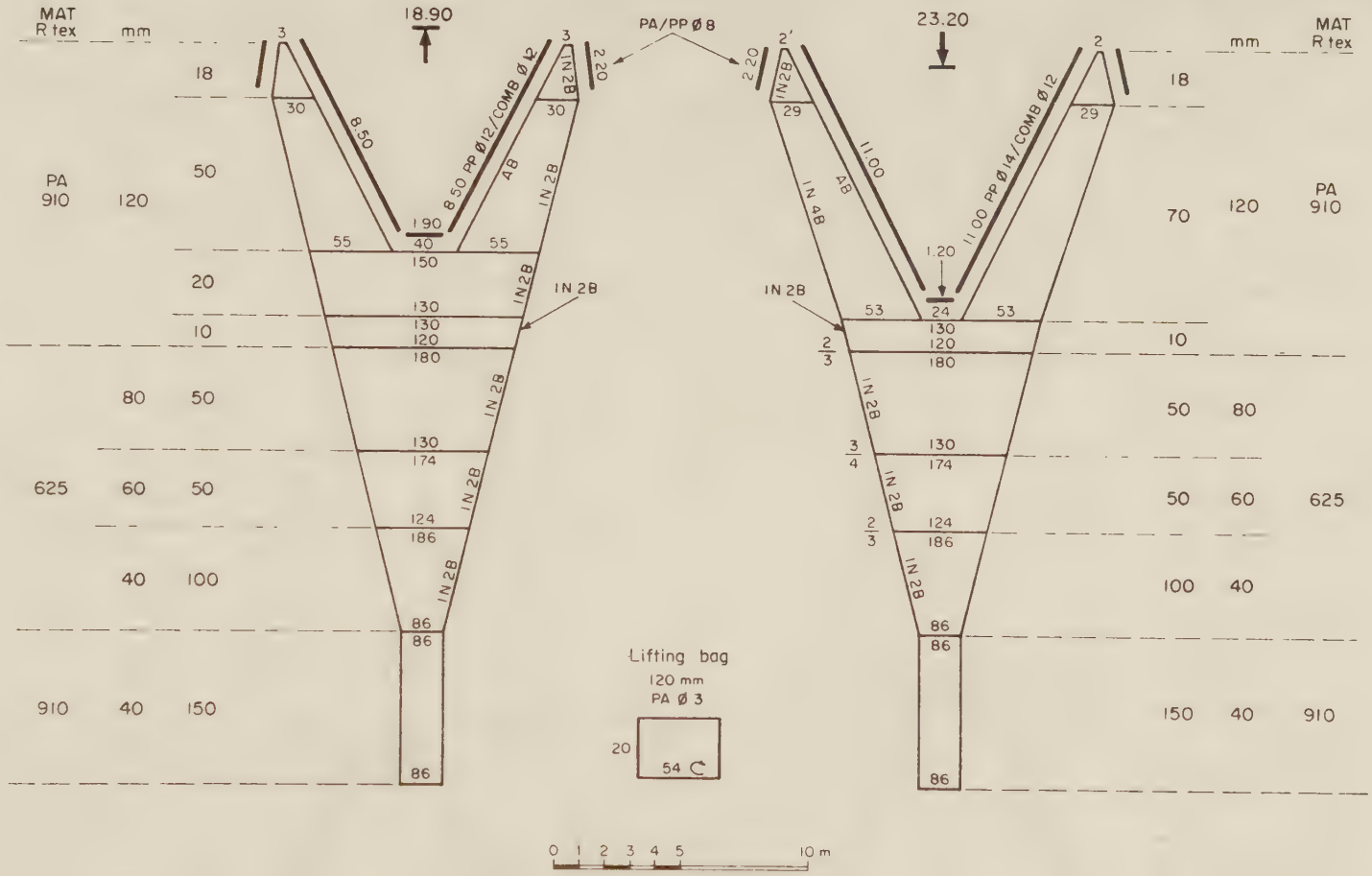


High opening bottom trawl 528 meshes of 60 mm (stretched)		
One boat 50 - 75 hp	Type A-1	Drwg. No 1
FAO, Rome, November 1977		

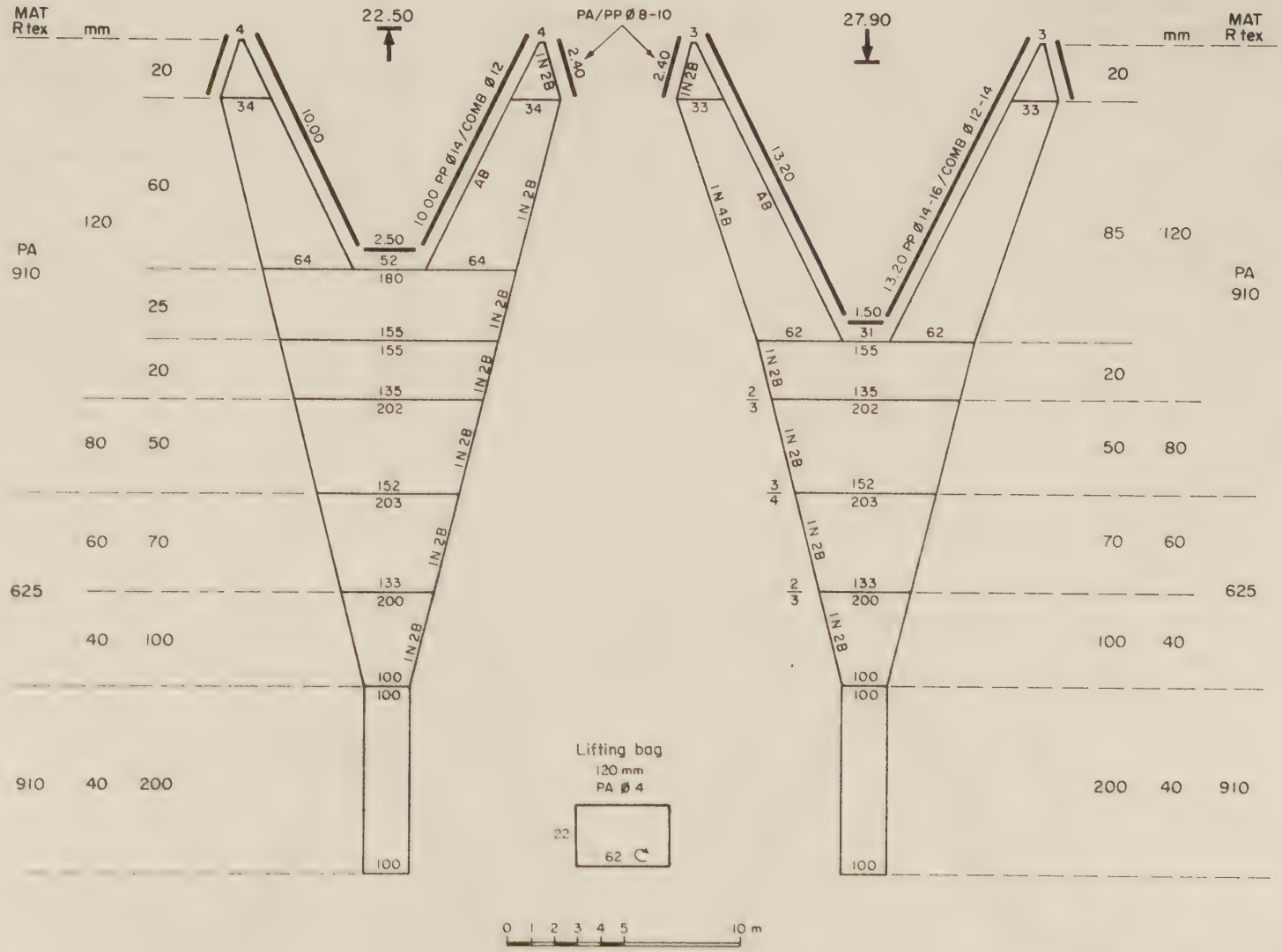


High opening bottom trawl 626 meshes of 60 mm (stretched)		
One boat 100-120 hp	Type A-2	Drwg. No 2
FAO, Rome, November 1977		

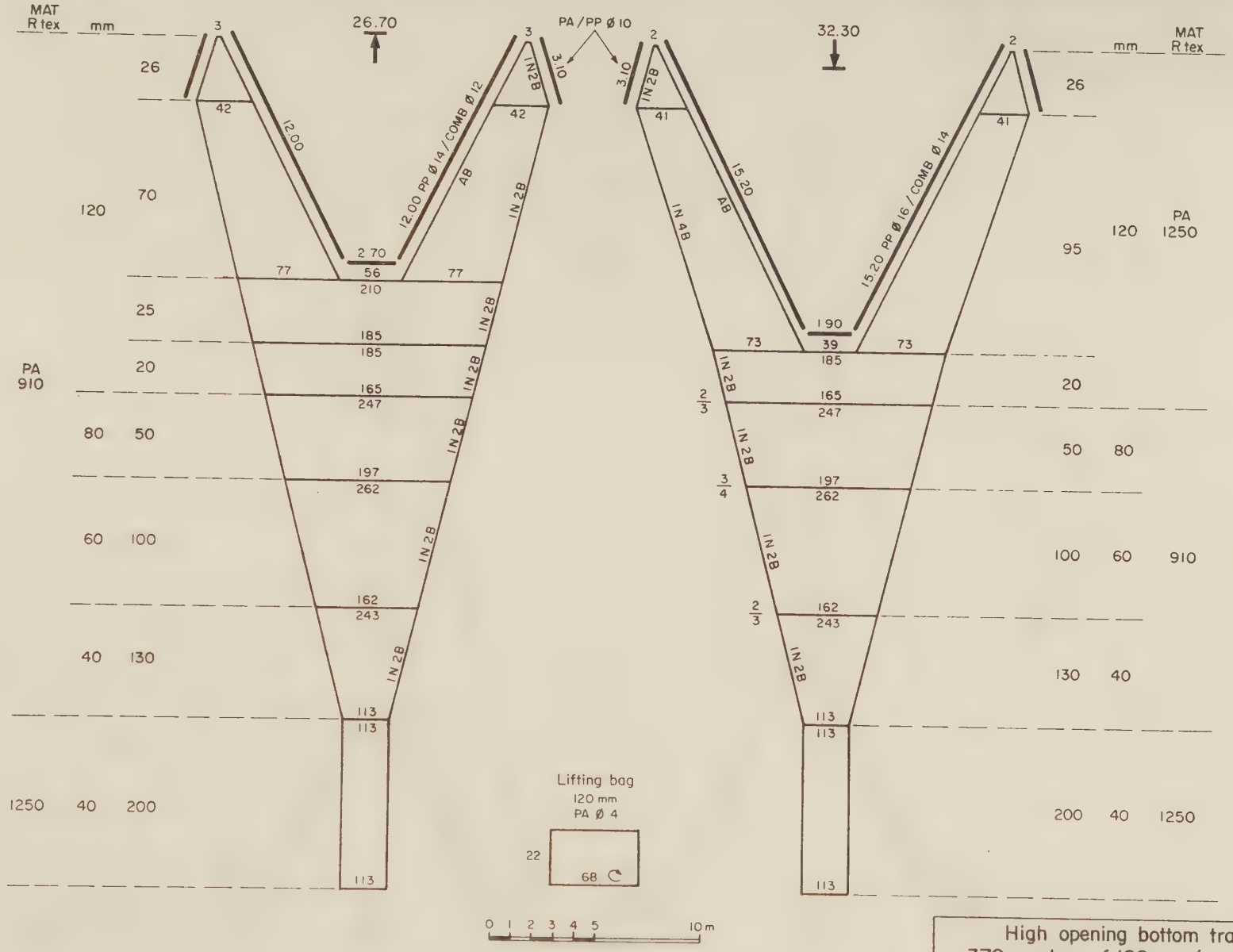

MAT
R tex
mm
28.70
PA/PP Ø 10
33.30
36
PA
1250
80
120
40
60
210
910
40
130
1250
40
200
3
57
13.10
13.10 PP Ø 14 / COMB Ø 12
2.90
IN 2B
4B
2.50
100
117
(156)
412
3/4
372
162
243
2/3
113
15.60
15.60 PP Ø 16 / COMB Ø 14
IN 4B
97
129
2.10
86
143
Lifting bag
120 mm
PA Ø 4
22
68
0 1 2 3 4 5 10 m
High opening bottom trawl
744 meshes of 60 mm (stretched)
One boat 150 - 180 hp
FAO, Rome, November 1977
Type
A-3
Drwg. No
3



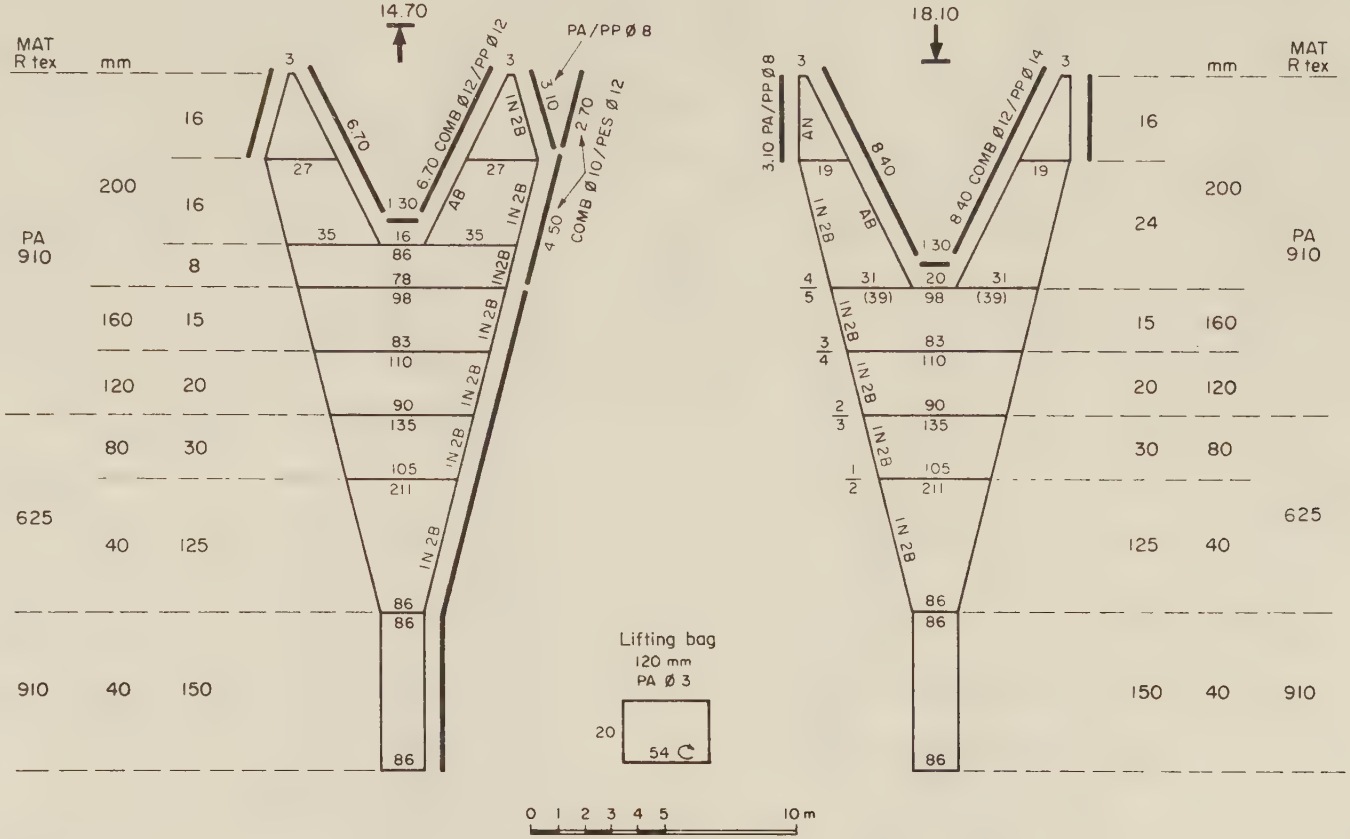
High opening bottom trawl 260 meshes of 120 mm (stretched)		
One boat 50-75 hp	Type	Drwg. No
FAO, Rome, November 1977	B-1	4



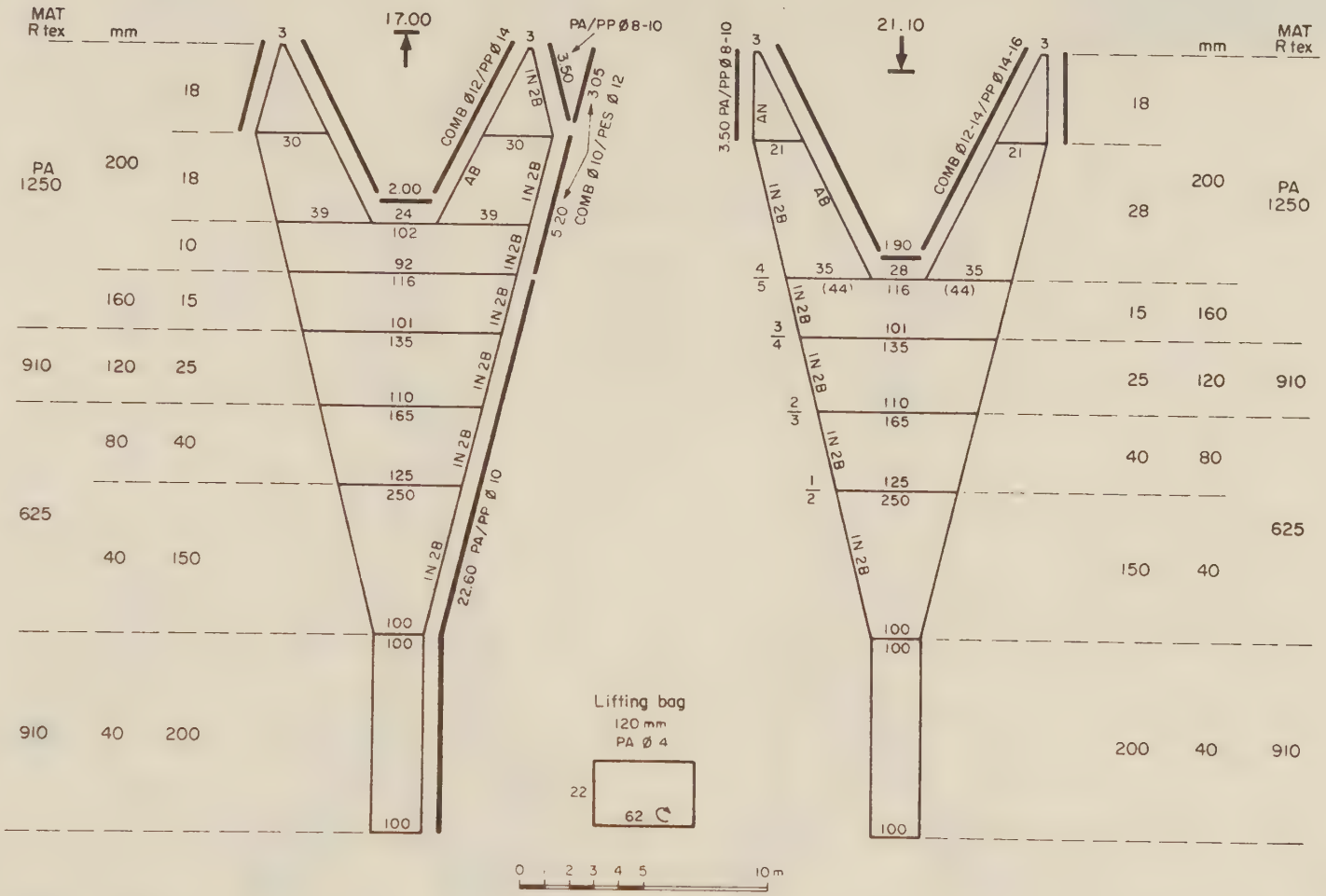
High opening bottom trawl 310 meshes of 120 mm (stretched)			
One boat 100 - 120 hp		Type B-2	Drwg. No 5
FAO, Rome, November 1977			



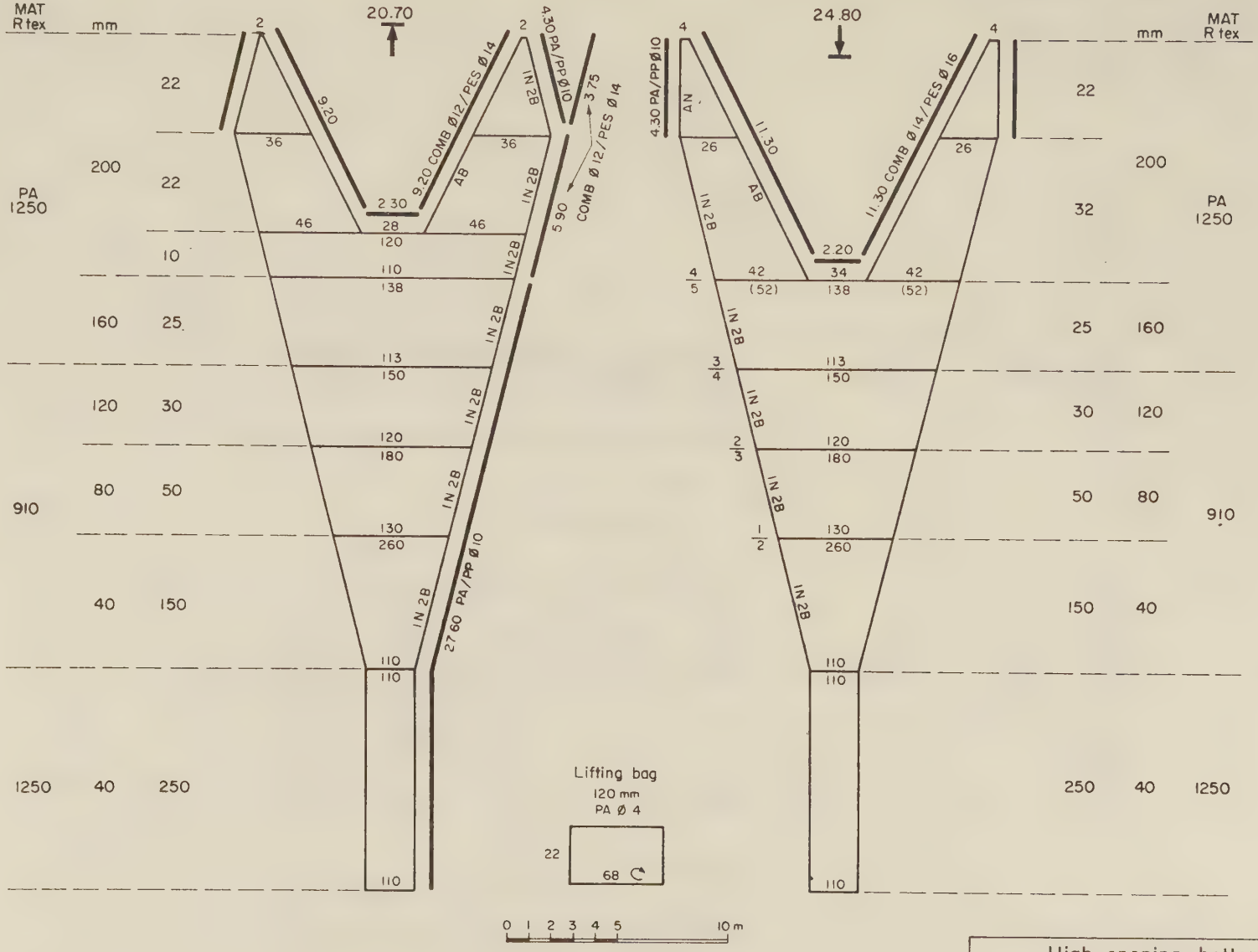
High opening bottom trawl 370 meshes of 120 mm (stretched)			
One boat 150 - 180 hp		Type	Drwg. No
FAO, Rome, November 1977		B-3	6



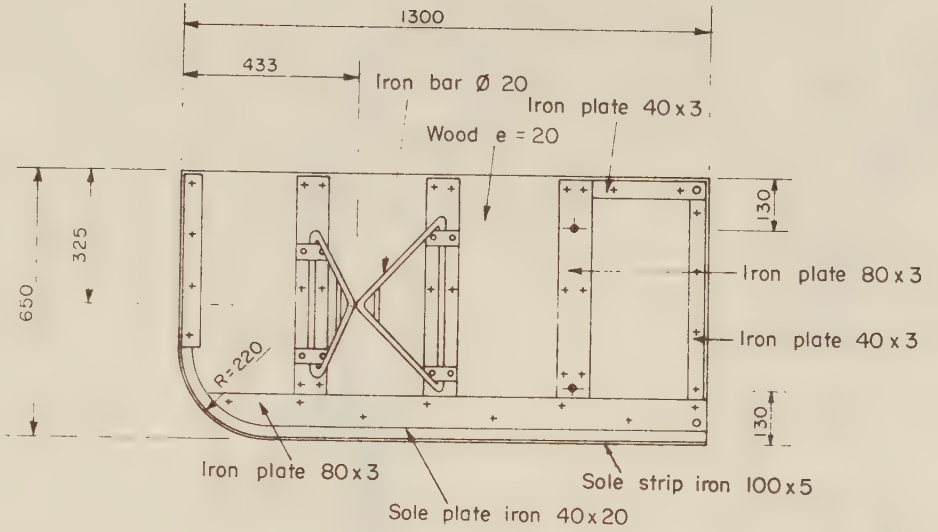
High opening bottom trawl 196 meshes of 160 mm (stretched)		
One boat 50 - 75 hp	Type C - 1	Drwg. No 7
FAO, Rome, November 1977		

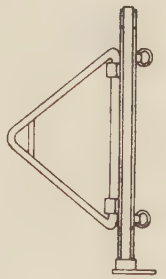


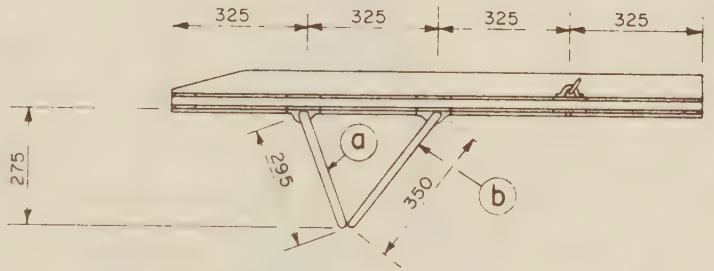
High opening bottom trawl 232 meshes of 160 mm (stretched)		
One boat 100 - 120 hp	Type	Drwg. No
FAO, Rome, November 1977	C-2	8

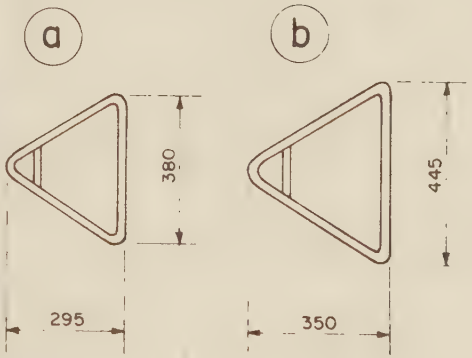


High opening bottom trawl 276 meshes of 160 mm (stretched)		
One boat 150 - 180 hp	Type C-3	Drwg. No 9
FAO, Rome, November 1977		



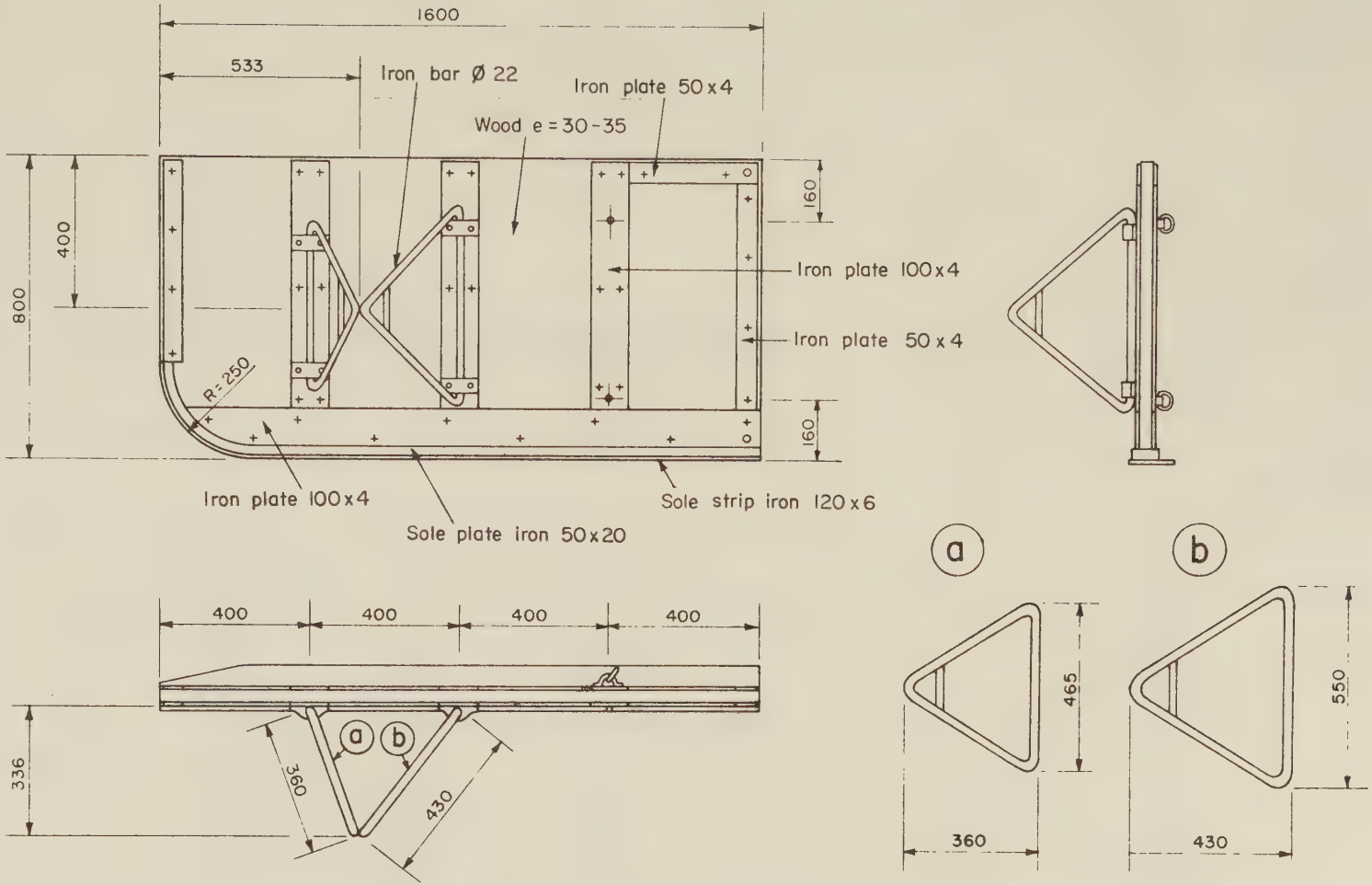






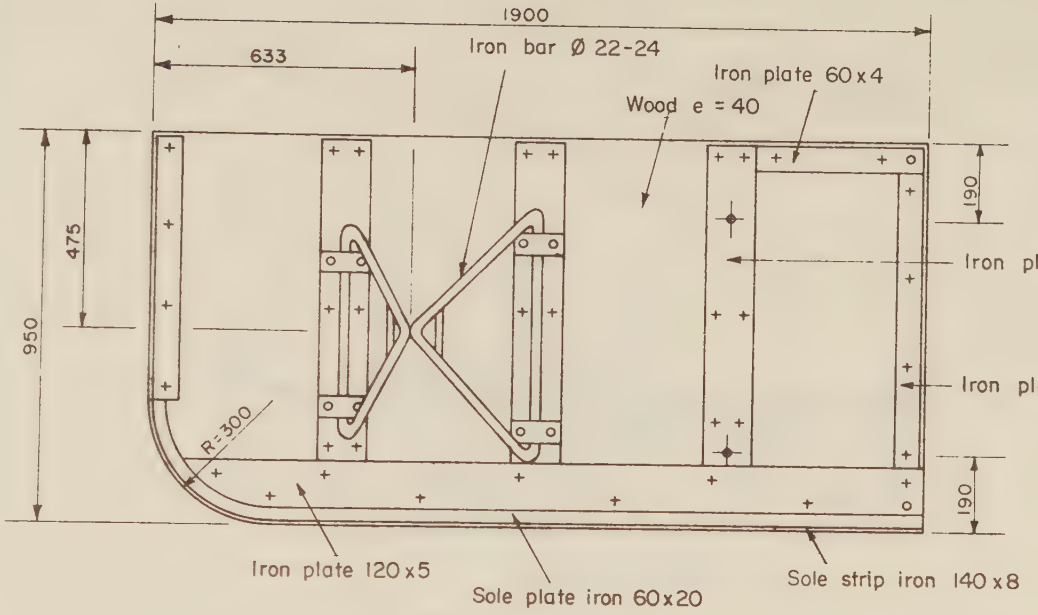
Weight : ~ 45 kg

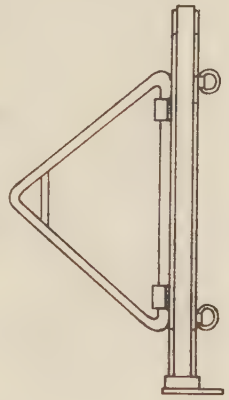
Otter board Trawl types A-1, B-1, C-1	
One boat 50-75 hp	Drwg. No 10
FAO, Rome, November 1977	

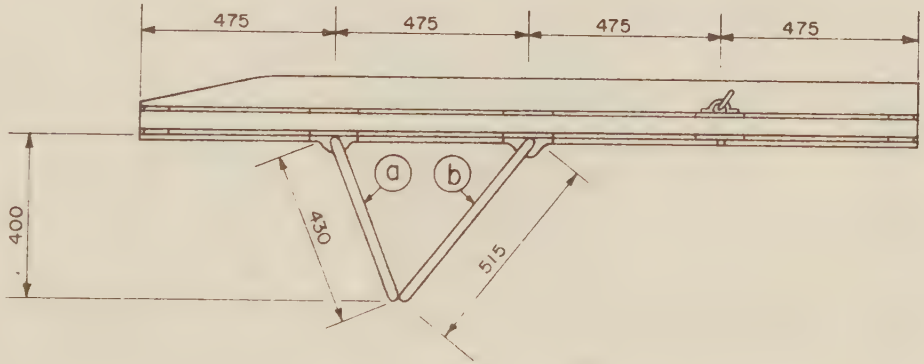


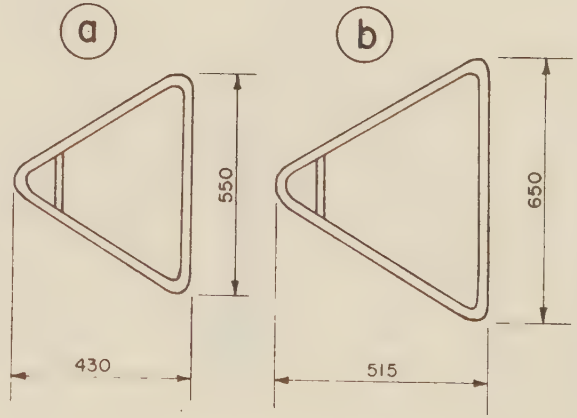
Weight : ~85-90 kg

Otter board Trawl types A-2, B-2, C-2	
One boat 100-120 hp	Drwg. No 11
FAO, Rome, November 1977	









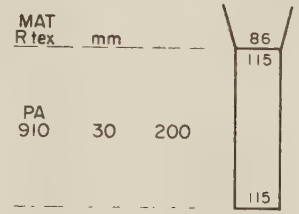
Weight : ~ 135 kg

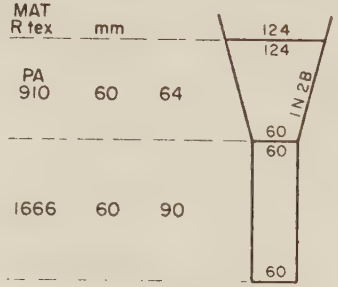
Otter board Trawl types A-3, B-3, C-3	
One boat 150 - 180 hp	Drwg. No 12
FAO, Rome, November 1977	

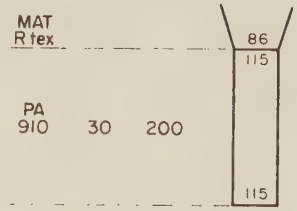
Trawl types A and B

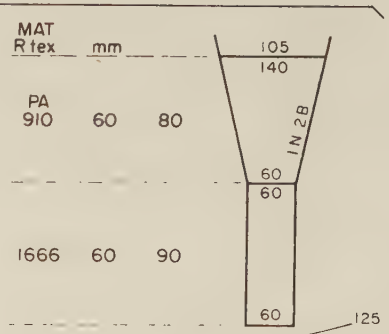
Trawl type C

50-75 hp

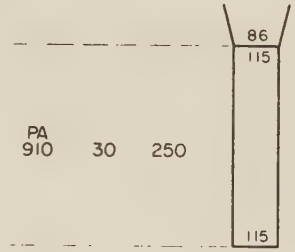


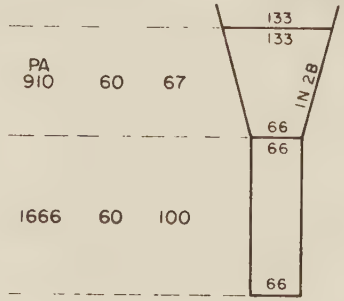


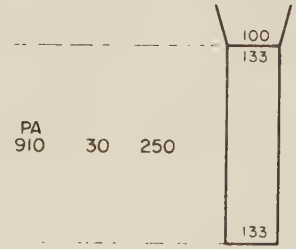


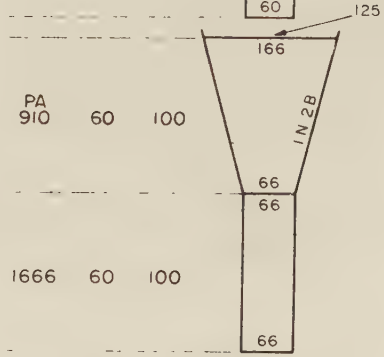


100-120 hp

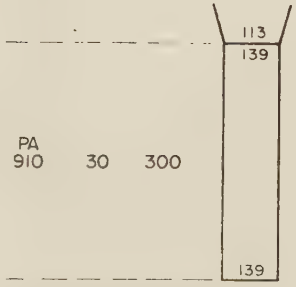


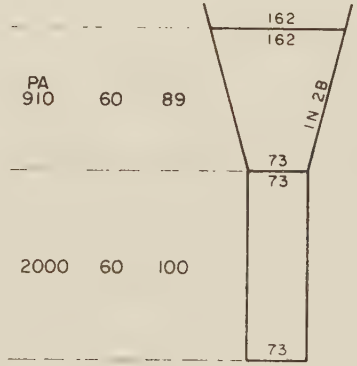


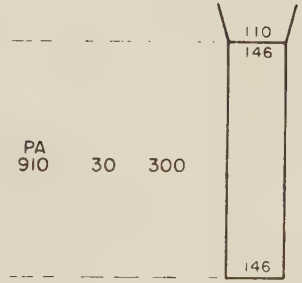


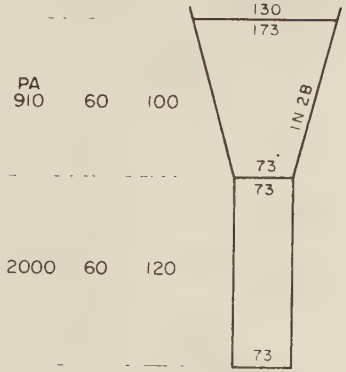


150-180 hp



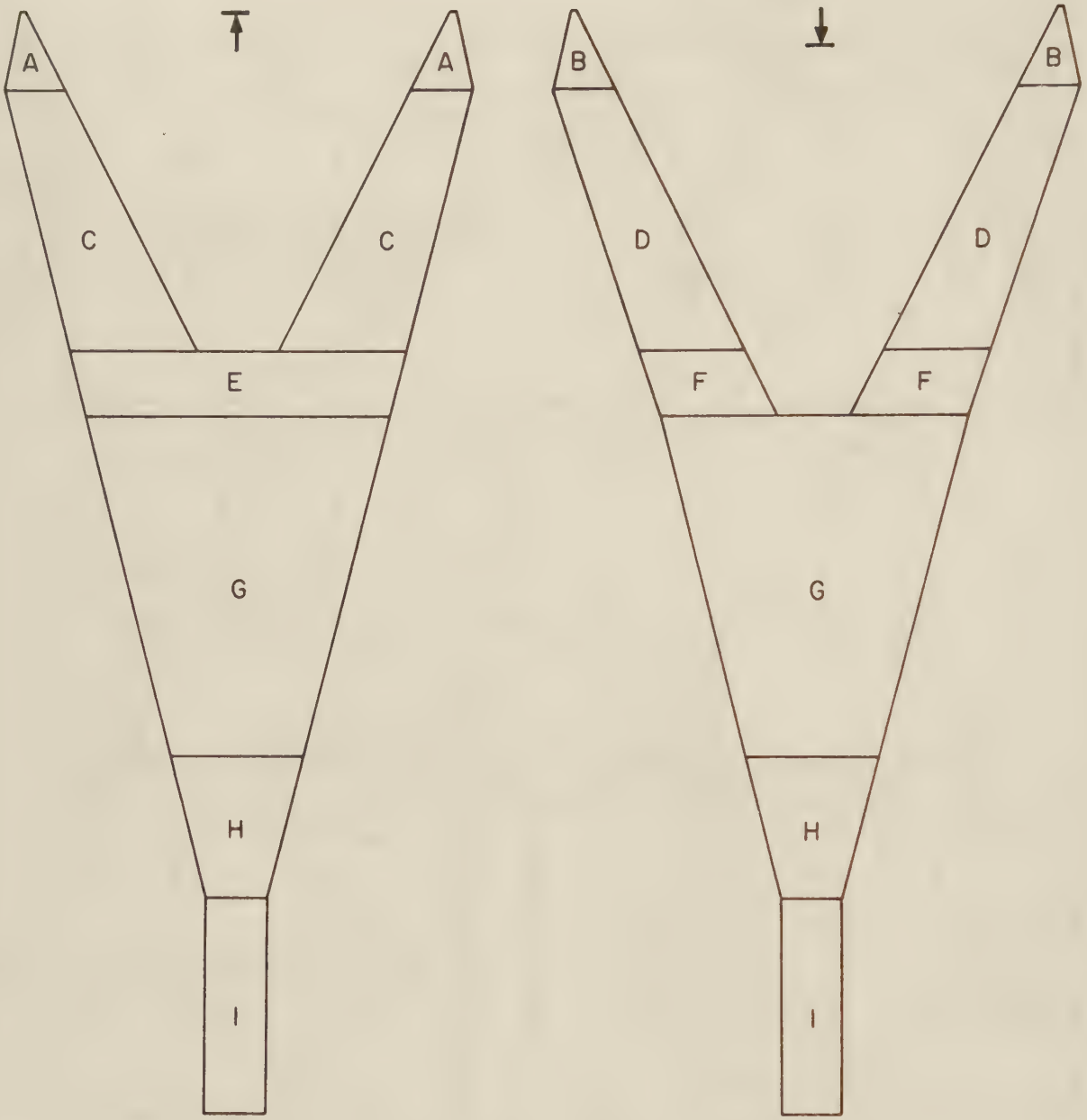






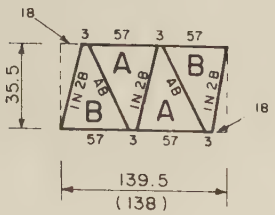
Alternative codends
with modified mesh sizes

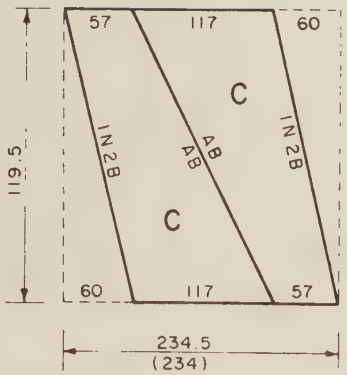
50 to 180 hp boats	Types	Drwg. No
FAO, Rome, November 1977	A-B-C	13

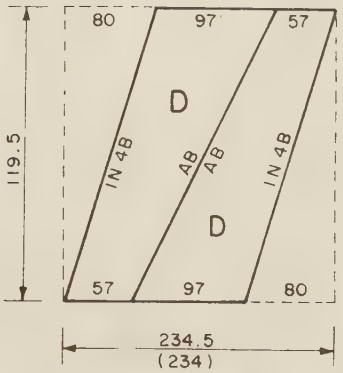


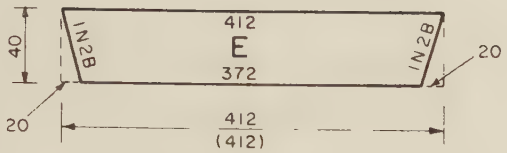
A Top wing tip
B Lower wing tip
C Top wing
D Lower wing I
E Square
F Lower wing II
G Top belly and lower belly
H Baitings
I Codend

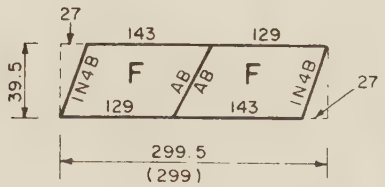
Designation of netting sections		
FAO, Rome, November 1977	Type A	Drwg. No 14

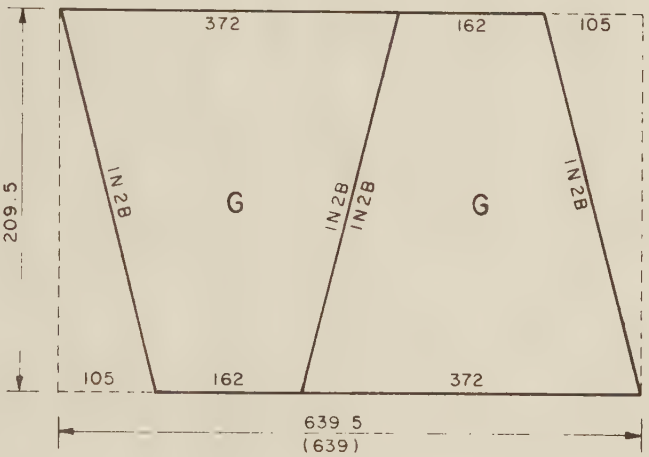


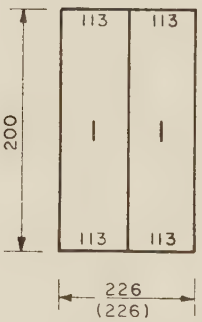


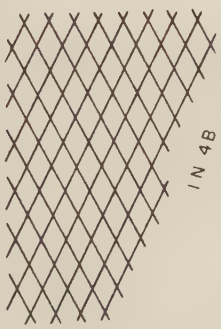


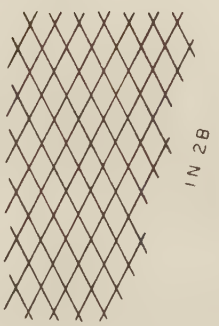


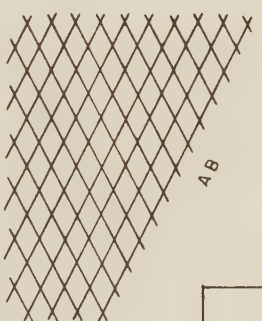










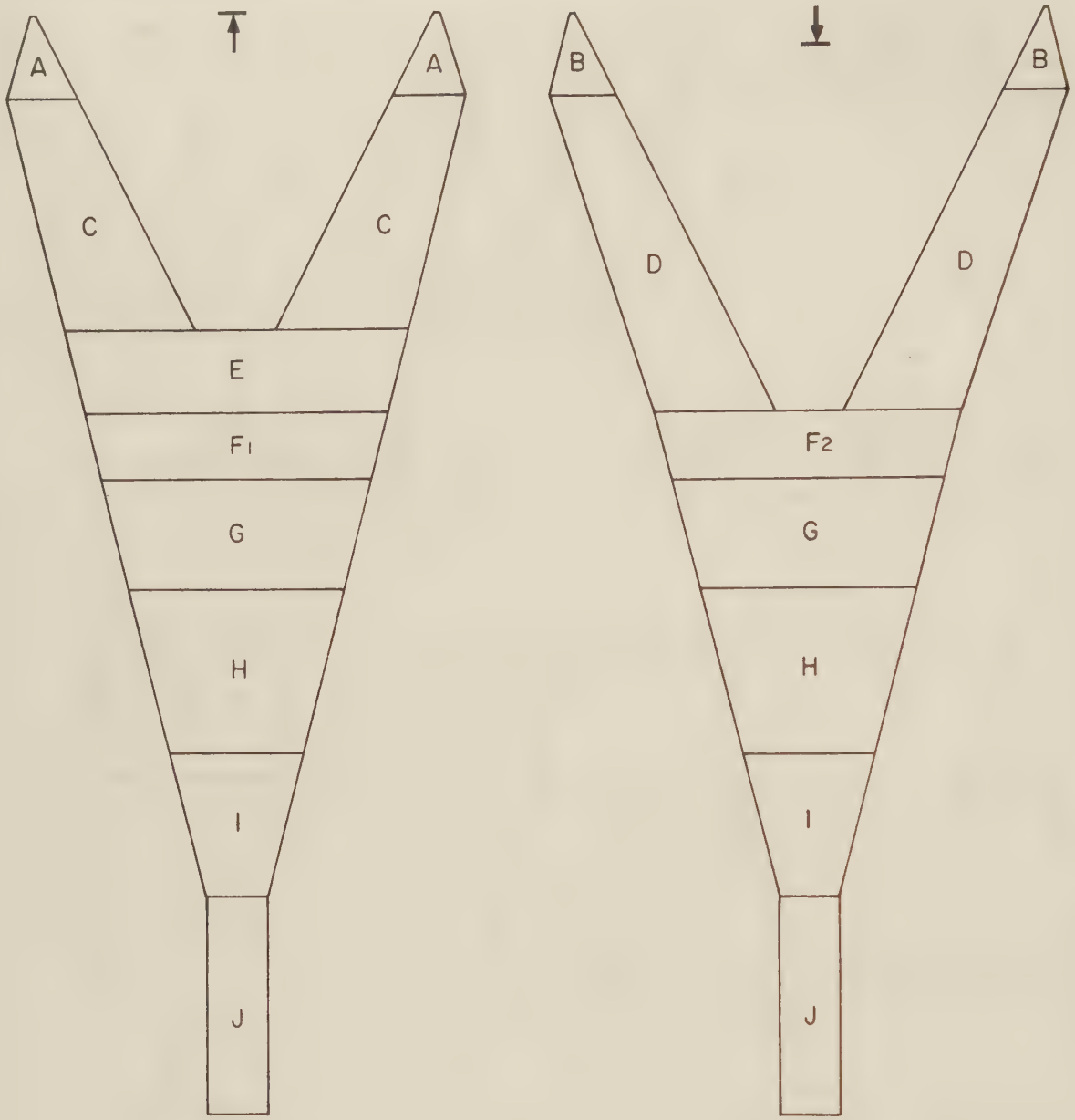


Cutting of netting sections
(Example)

FAO, Rome, November 1977

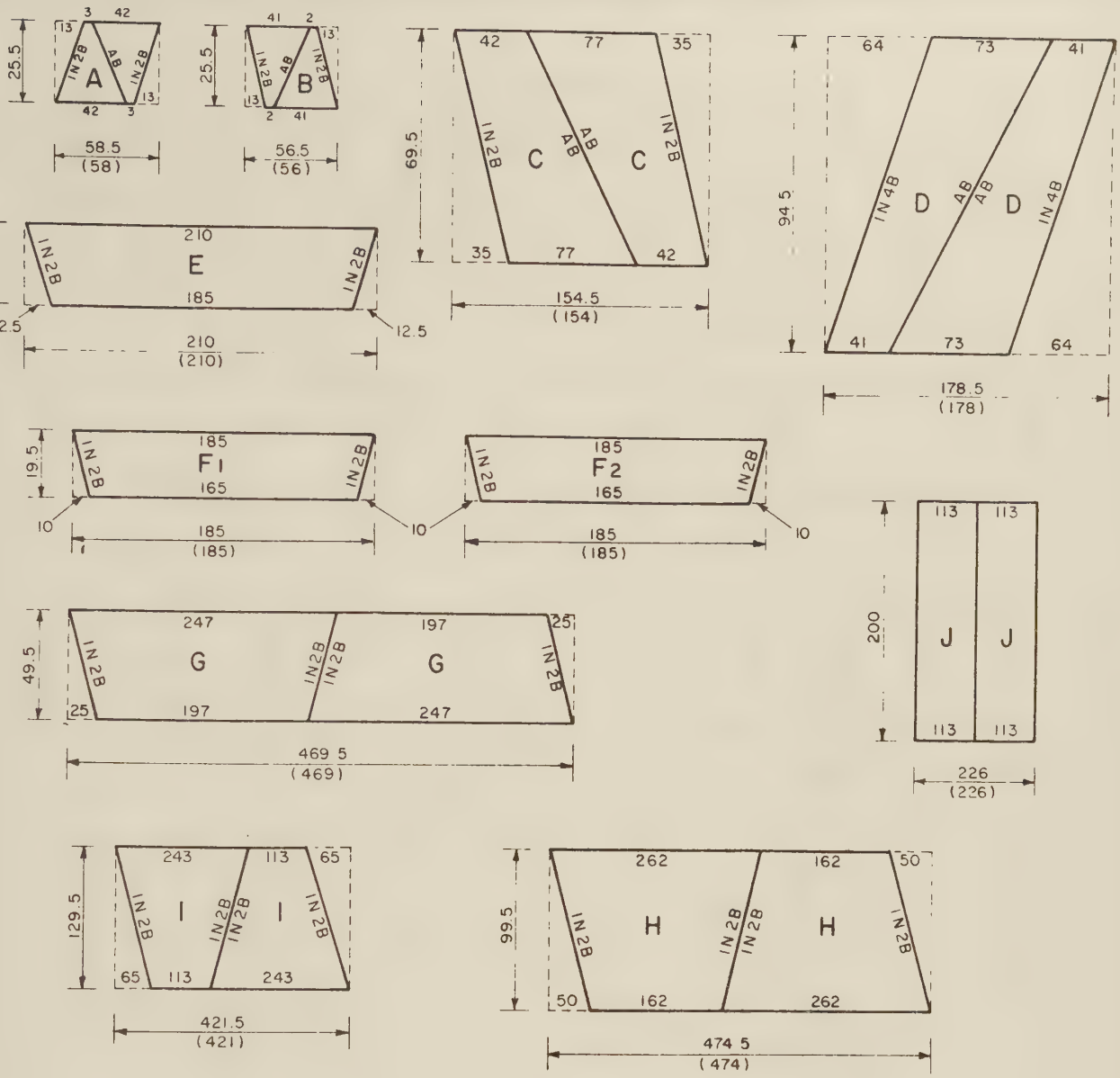
Type A-3

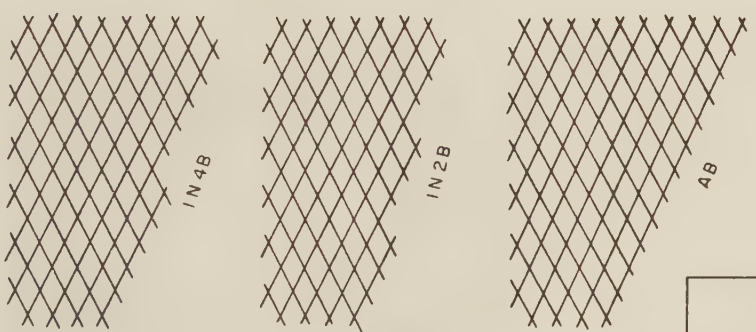
Drwg. No 15



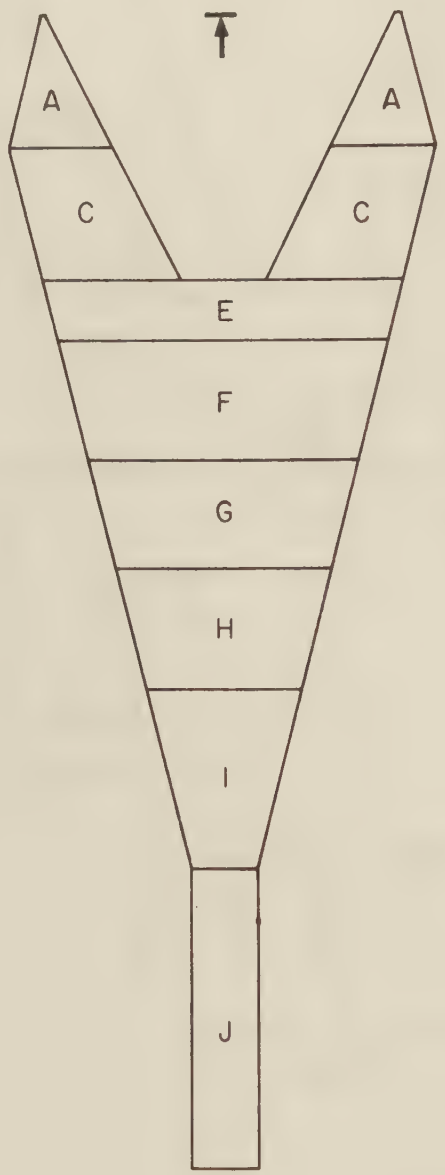
A Top wing tip
B Lower wing tip
C Top wing
D Lower wing
E Square
F1 Top belly I
F2 Lower belly I
G Top belly II and lower belly II
H Top belly III and lower belly III
I Baitings
J Codend

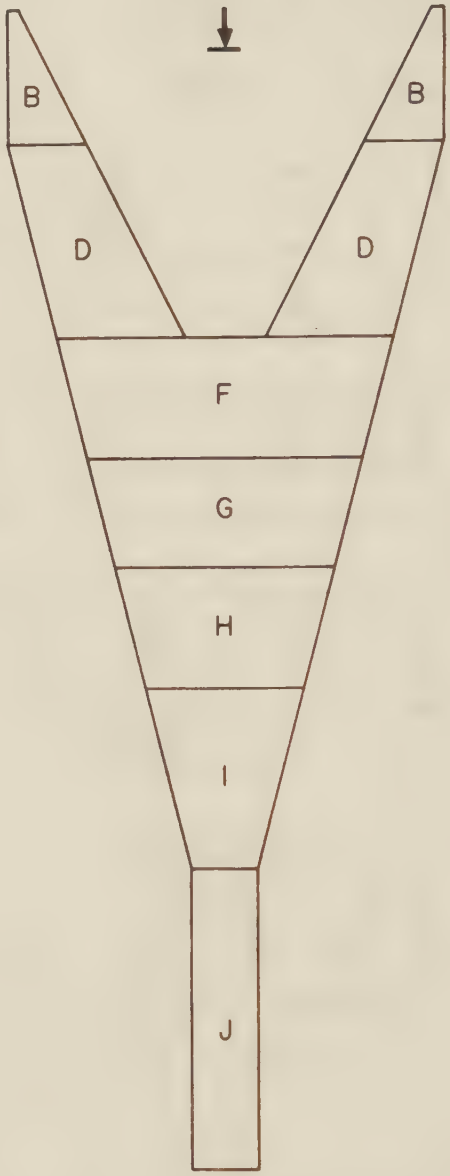
Designation of netting sections		
FAO, Rome, November 1977	Type B	Drwg. No 16





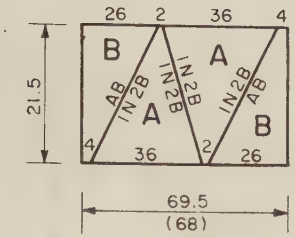
Cutting of netting sections (Example)		
	Type	Drwg. No
FAO, Rome, November 1977	B-3	17

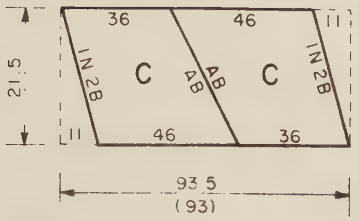


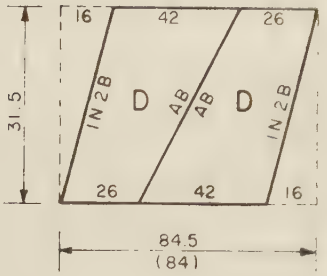


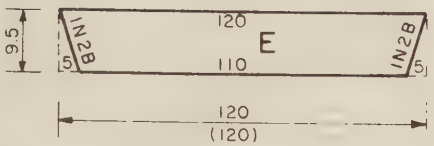
A Top wing tip
B Lower wing tip
C Top wing
D Lower wing
E Square
F Top belly I and lower belly I
G Top belly II and lower belly II
H Top belly III and lower belly III
I Baitings
J Codend

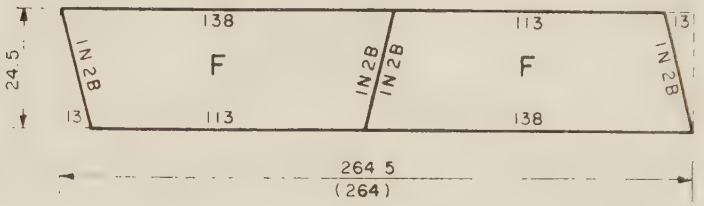
Designation of netting sections		
FAO, Rome, November 1977	Type C	Drwg. No 18

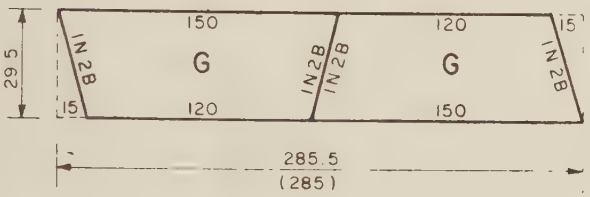


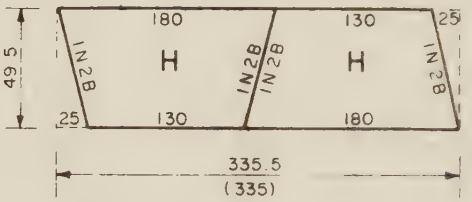


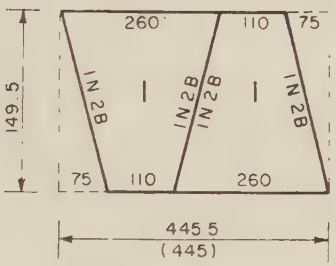


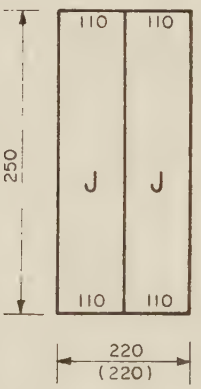


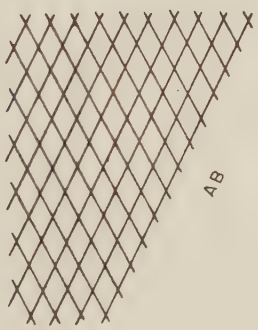


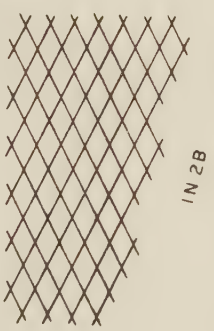








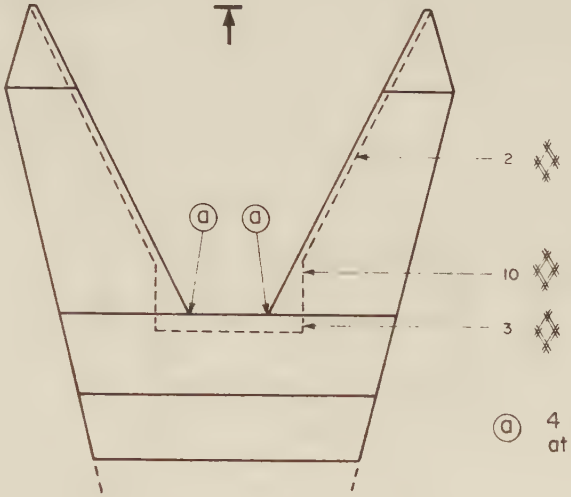


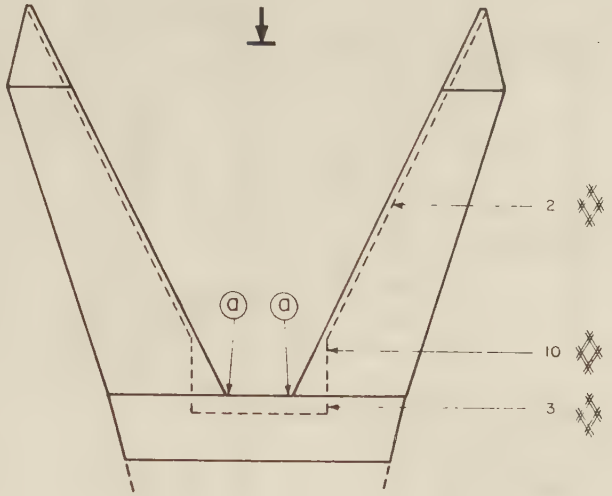


Cutting of netting sections
(Example)

	Type	Drwg. No
FAO, Rome, November 1977	C-3	19

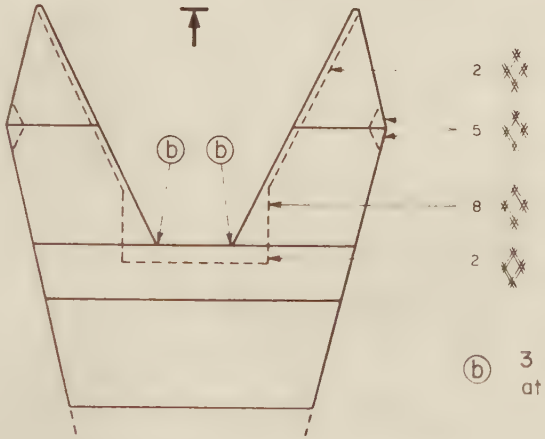
Trawl types A and B

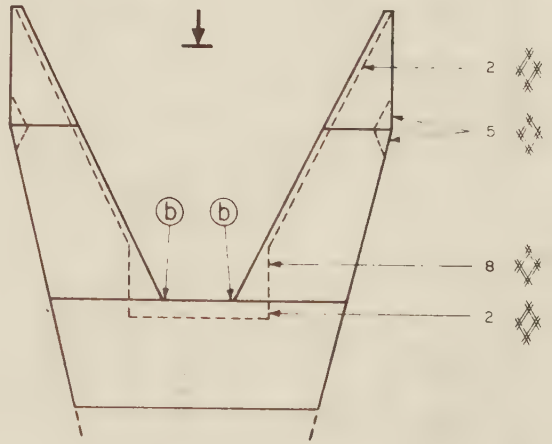




ⓐ 4 meshes pinched at each corner

Trawl type C



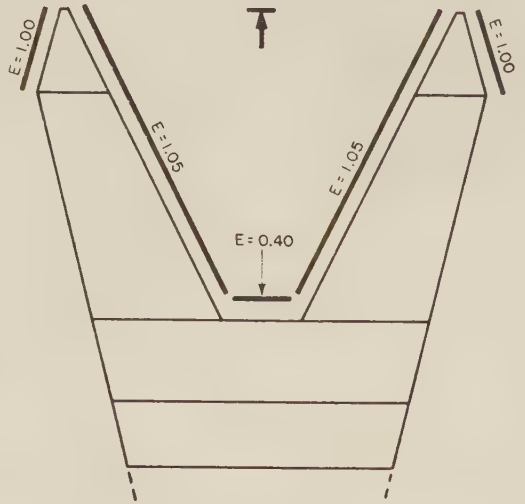


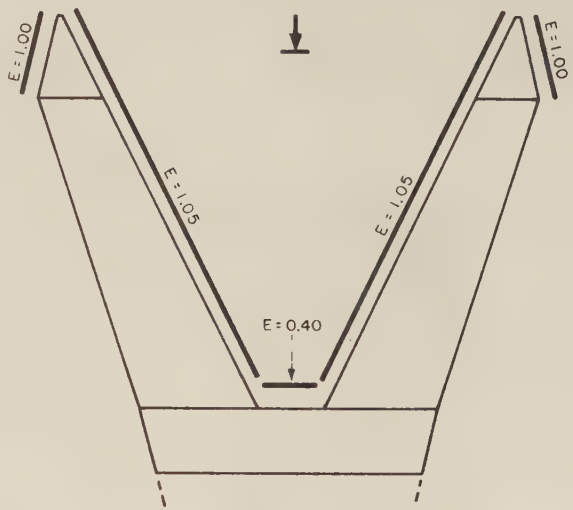
ⓑ 3 meshes pinched at each corner

Double braided meshes

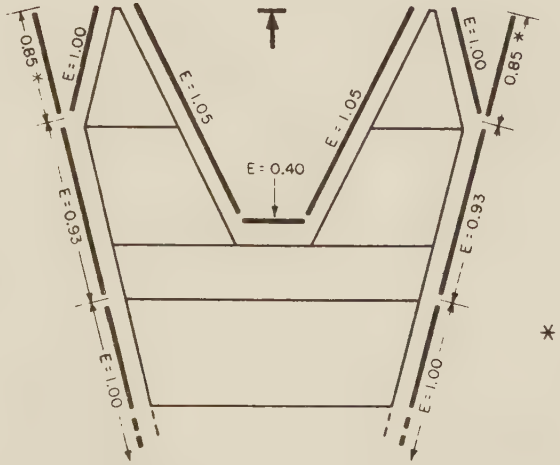
Reinforcing parts		
FAO, Rome, November 1977	Types A-B-C	Drwg.No 20

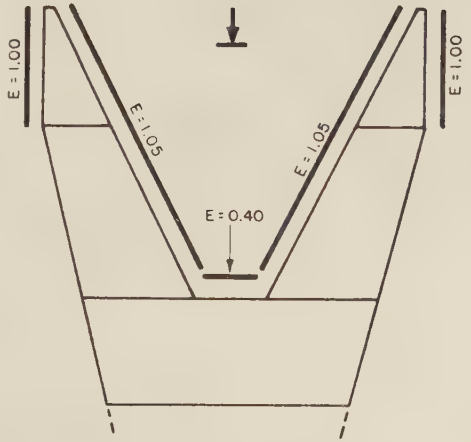
Trawl types A and B





Trawl type C

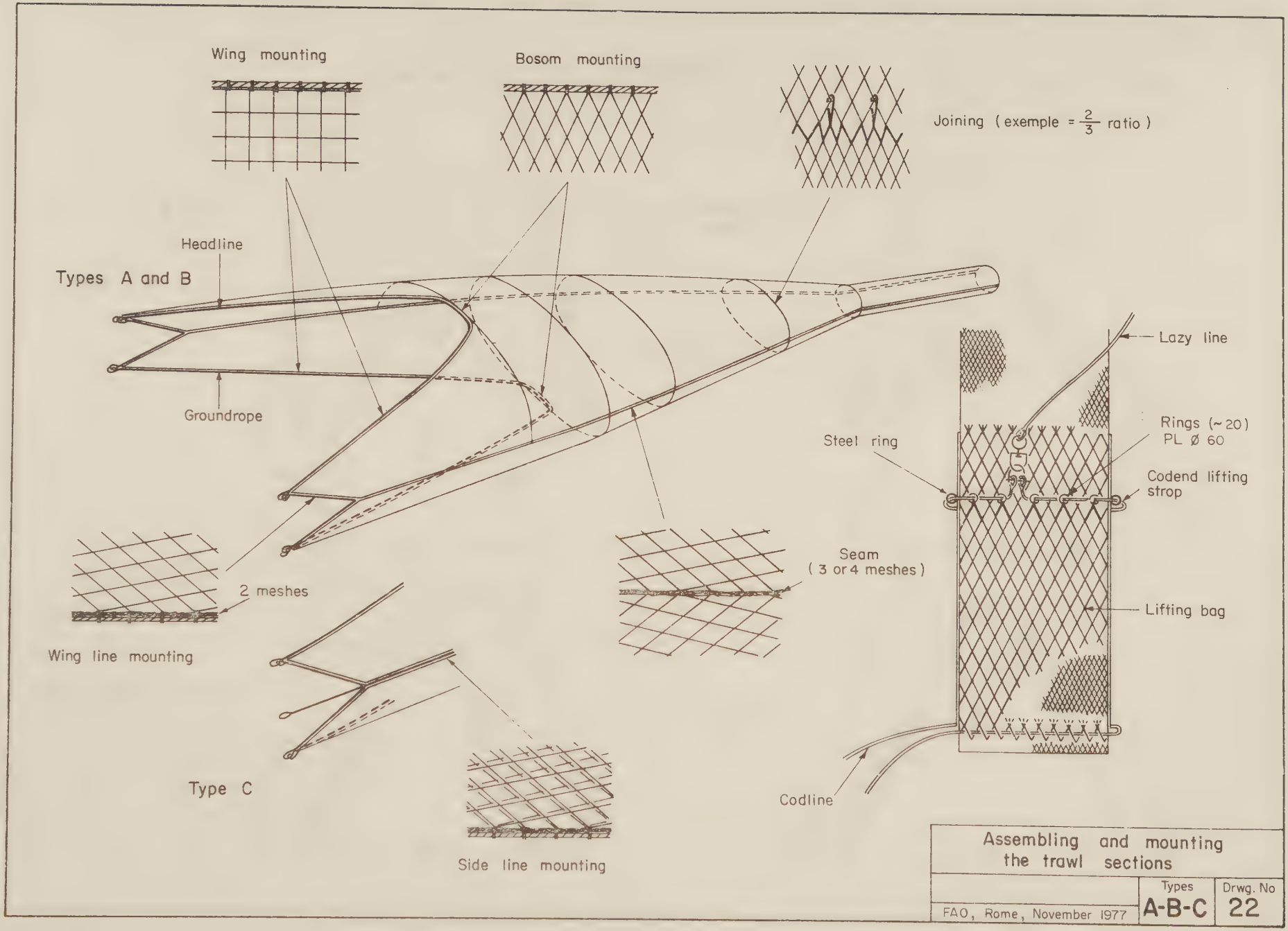


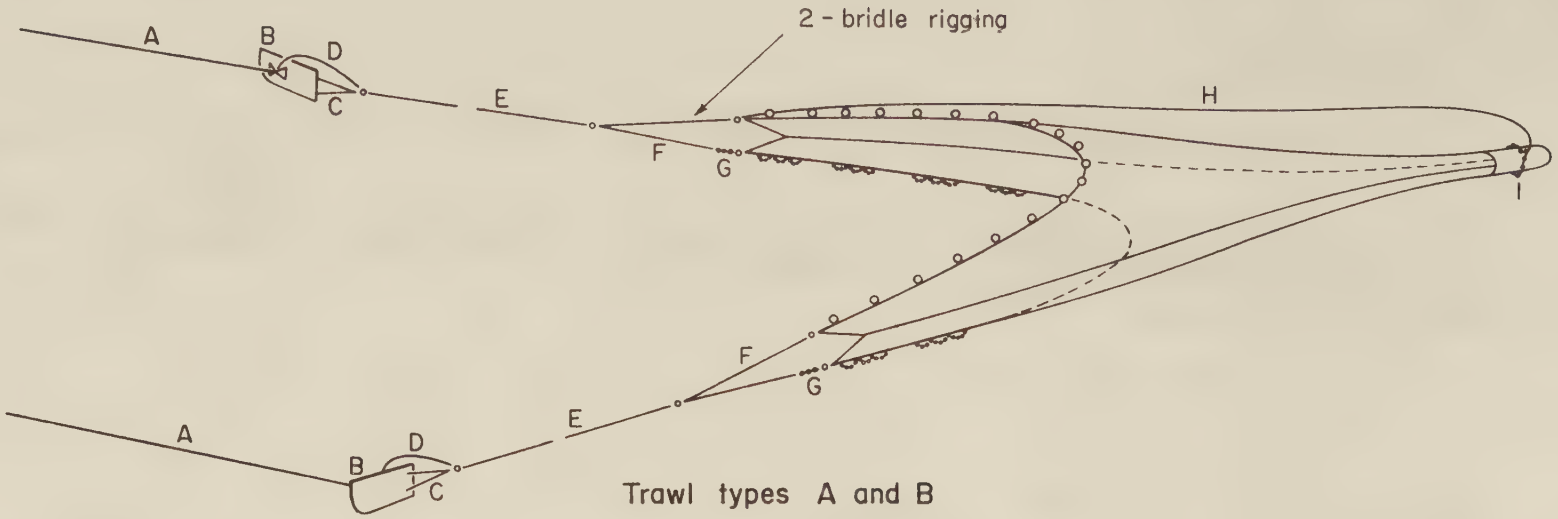


* of the length of the stretched wing tip

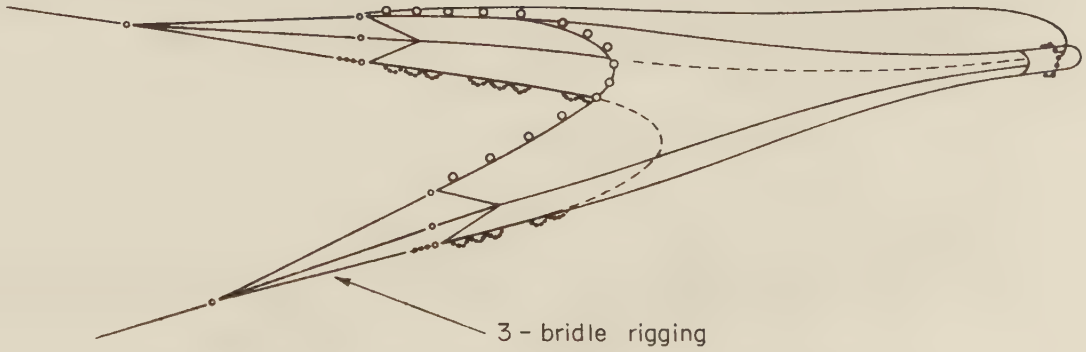
Hanging ratio $E = \frac{\text{length of rope}}{\text{length of stretched netting}}$

Hanging on ropes		
FAO, Rome, November 1977	Types A-B-C	Drwg. No 21


Wing mounting
Bosom mounting
Joining (exemple = 2/3 ratio)
Headline
Types A and B
Groundrope
Lazy line
Rings (~20)
PL Ø 60
Steel ring
Codend lifting strop
Seam
(3 or 4 meshes)
2 meshes
Lifting bag
Wing line mounting
Type C
Codline
Side line mounting
Assembling and mounting the trawl sections
FAO, Rome, November 1977
Types
A-B-C
Drwg. No
22



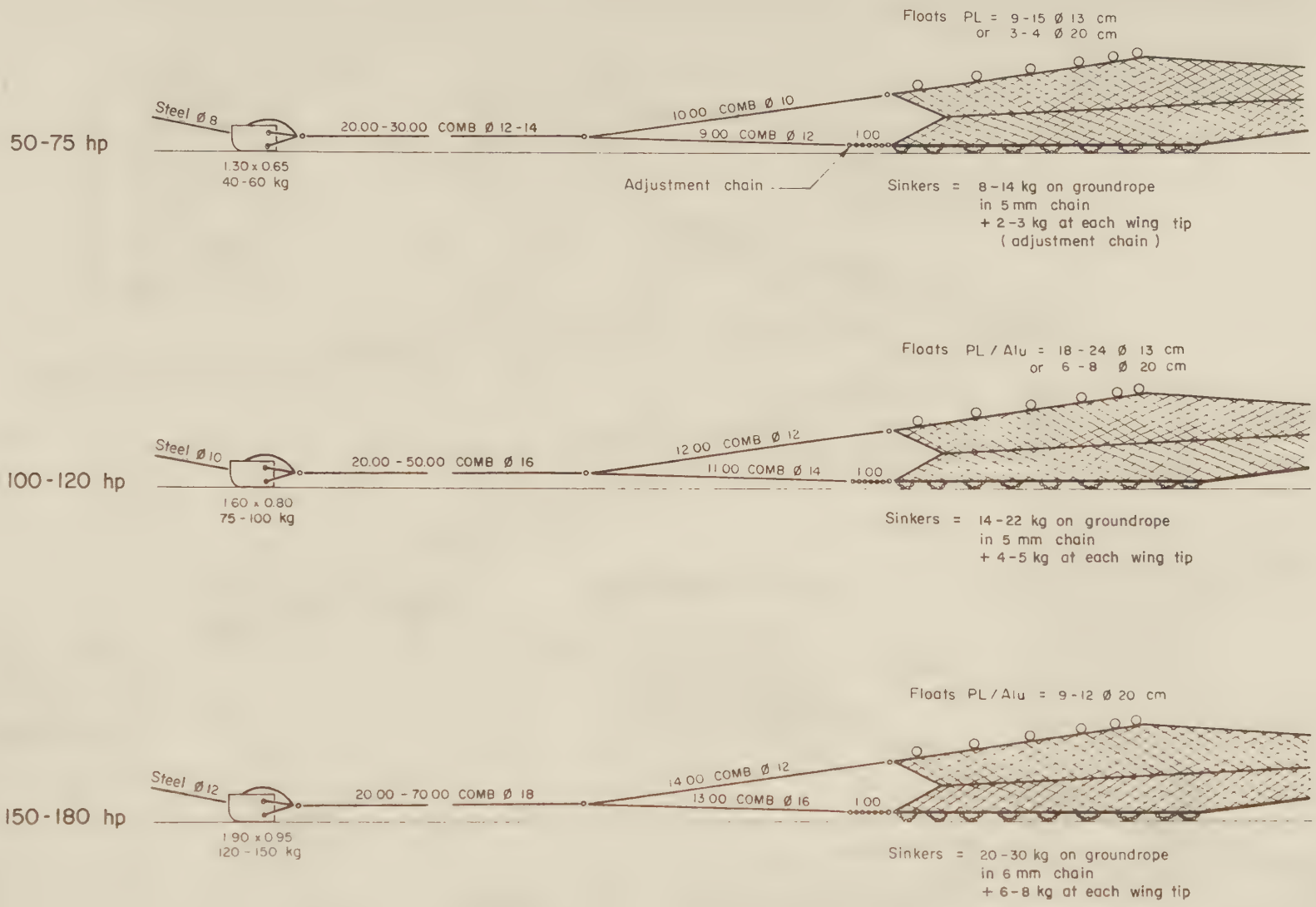
Trawl types A and B



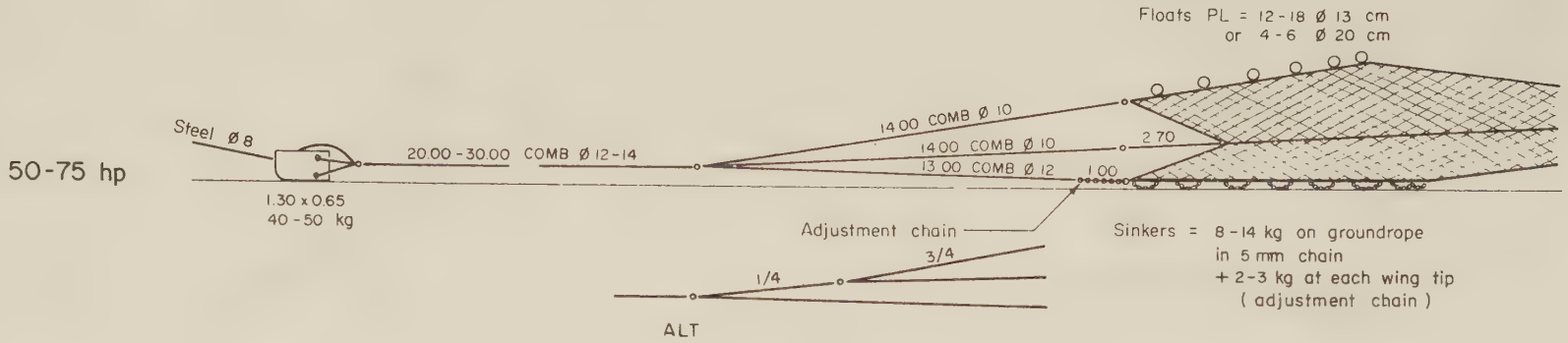
Trawl type C

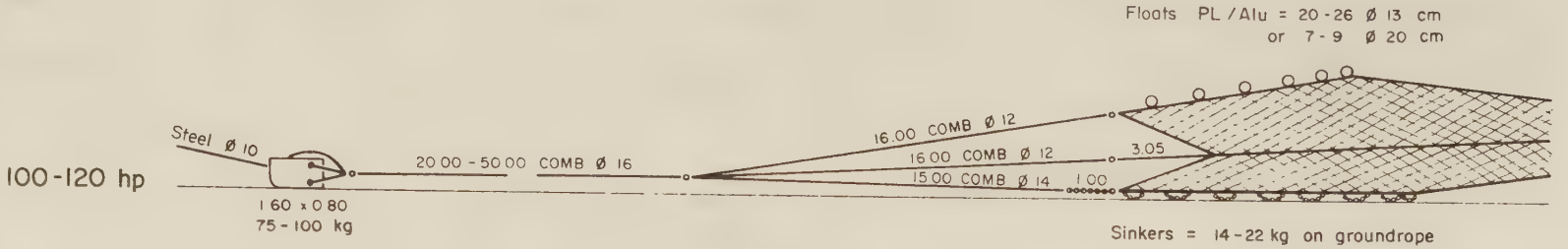
A Warps
B Otter boards
C Back strops
D Pennants
E Sweeplines
F Bridles
G Adjustment chain
H Lazy line
I Codend lifting strop

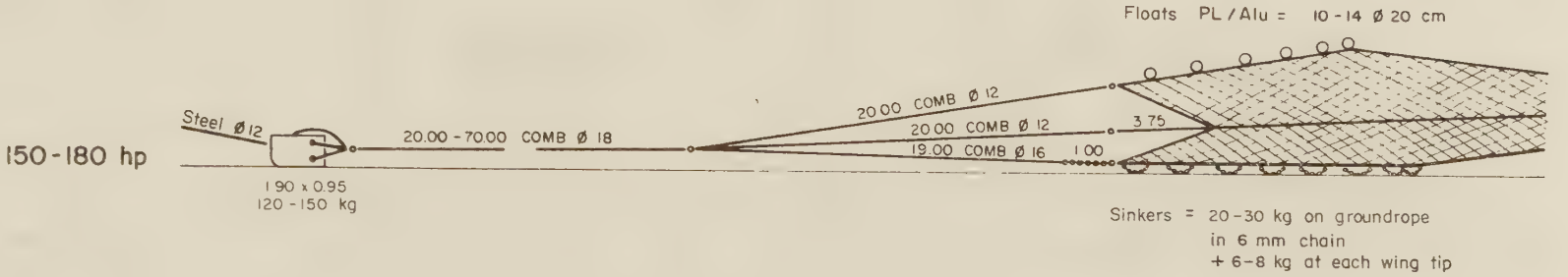
Rigging the trawl General arrangement		
	Types A-B-C	Drwg. No 23
FAO, Rome, November 1977		


50-75 hp
Floats PL = 9-15 Ø 13 cm
or 3-4 Ø 20 cm
Steel Ø 8
20.00-30.00 COMB Ø 12-14
10.00 COMB Ø 10
9.00 COMB Ø 12
1.00
1.30 x 0.65
40-60 kg
Adjustment chain
Sinkers = 8-14 kg on groundrope
in 5 mm chain
+ 2-3 kg at each wing tip
(adjustment chain)
100-120 hp
Floats PL / Alu = 18-24 Ø 13 cm
or 6-8 Ø 20 cm
Steel Ø 10
20.00-50.00 COMB Ø 16
12.00 COMB Ø 12
11.00 COMB Ø 14
1.00
1.60 x 0.80
75-100 kg
Sinkers = 14-22 kg on groundrope
in 5 mm chain
+ 4-5 kg at each wing tip
150-180 hp
Floats PL / Alu = 9-12 Ø 20 cm
Steel Ø 12
20.00-70.00 COMB Ø 18
14.00 COMB Ø 12
13.00 COMB Ø 16
1.00
1.90 x 0.95
120-150 kg
Sinkers = 20-30 kg on groundrope
in 6 mm chain
+ 6-8 kg at each wing tip

Rigging the trawl I. With sweepline and 2 bridles		
50 to 180 hp boats FAO, Rome, November 1977	Types A-B	Drwg. No 24



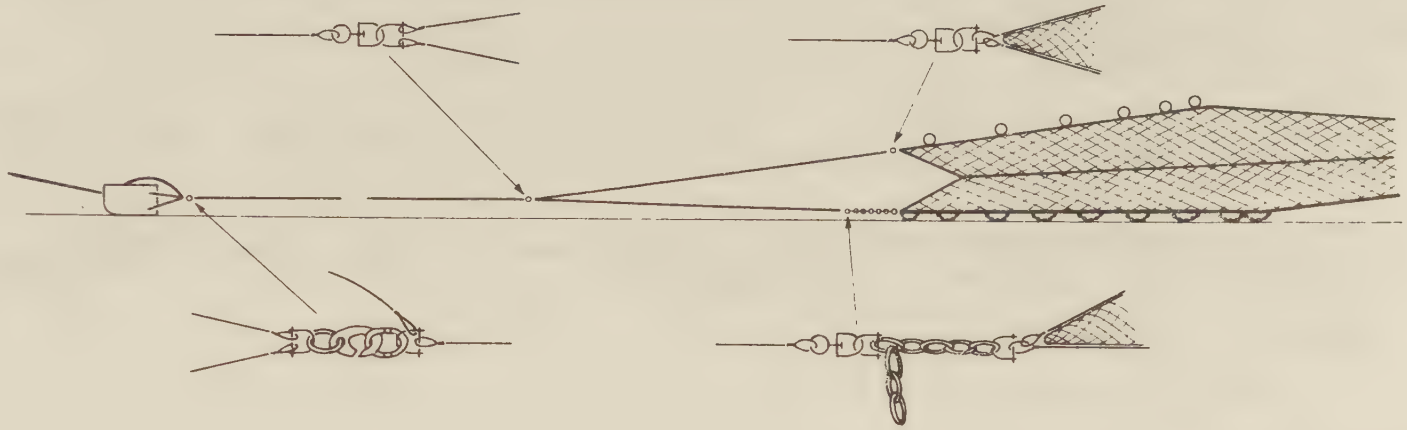




Rigging the trawl II. With sweepline and 3 bridles		
50 to 180 hp boats	Type	Drwg. No
FAO, Rome, November 1977	C	25

Trawl types
A and B

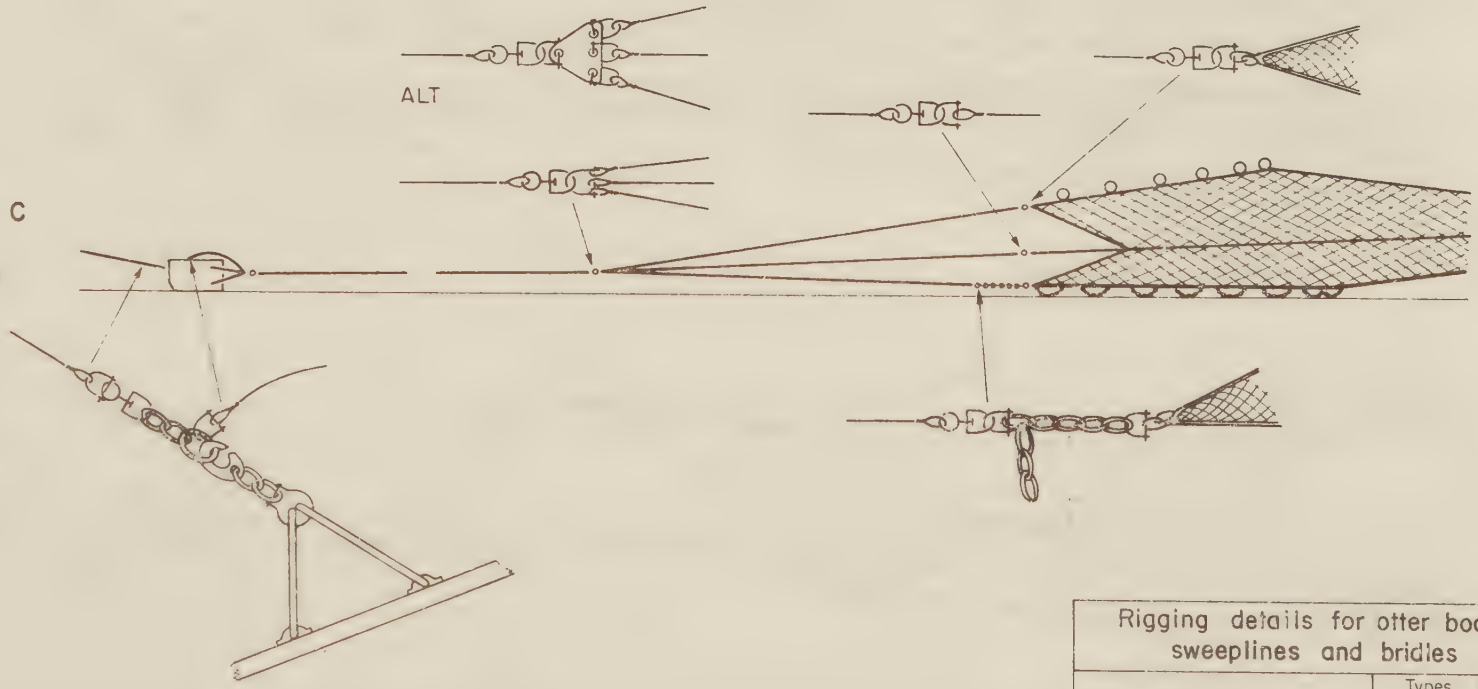
2 - bridle rigging



ALT

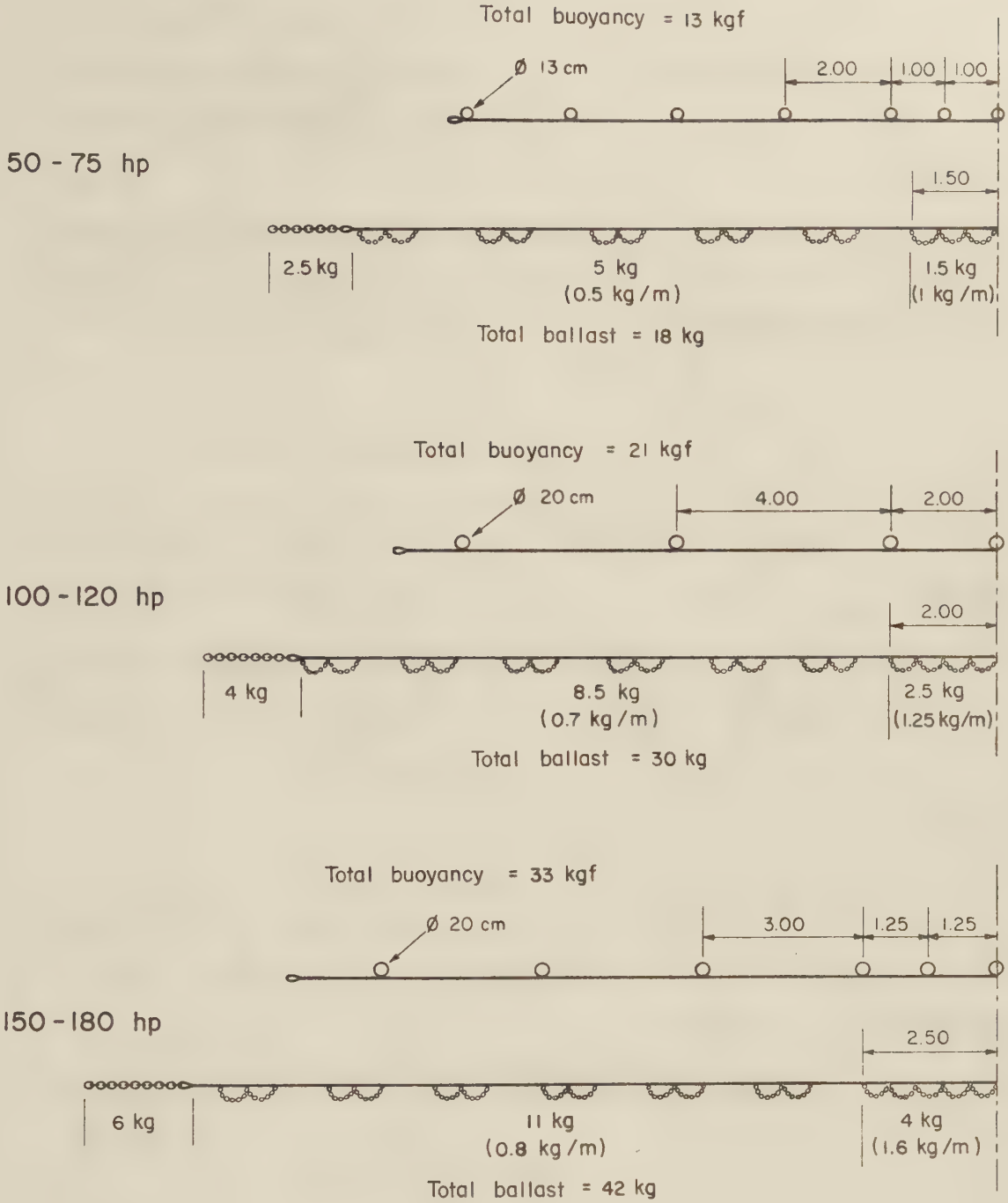
Trawl type C

3 - bridle rigging



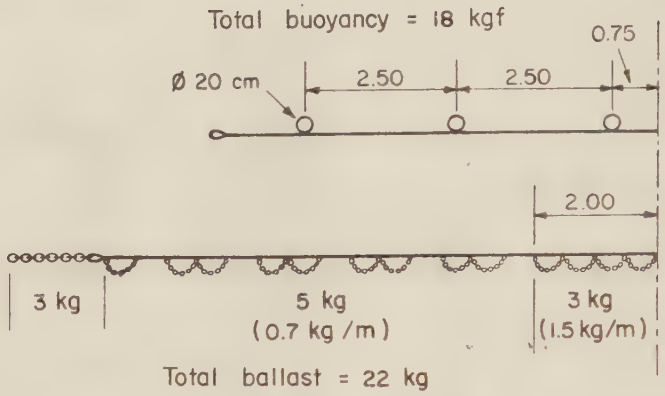
Rigging details for otter boards, sweeplines and bridles

	Types	Drwg. No
FAO, Rome, November 1977	A-B-C	26

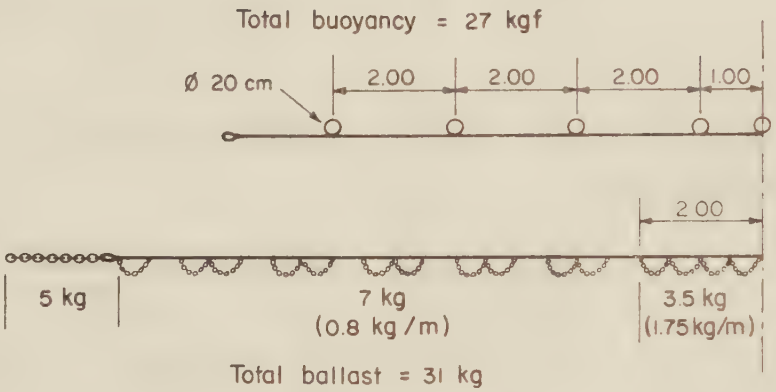


Distribution of floats and ballast Examples (1)		
50 to 180 hp boats	Types A-B	Drwg. No 27
FAO, Rome, November 1977		

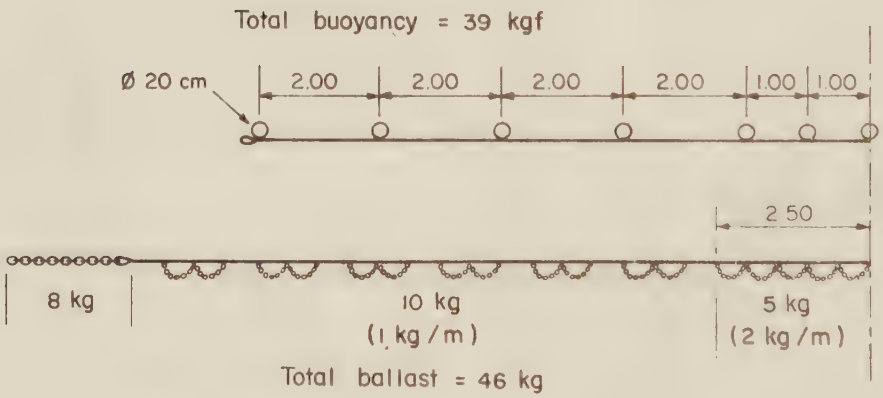
50 - 75 hp



100 - 120 hp

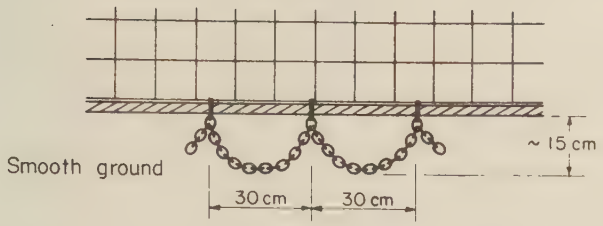


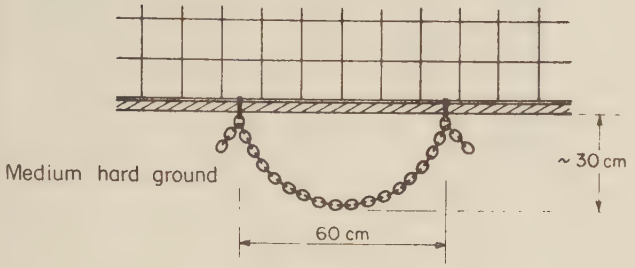
150 - 180 hp

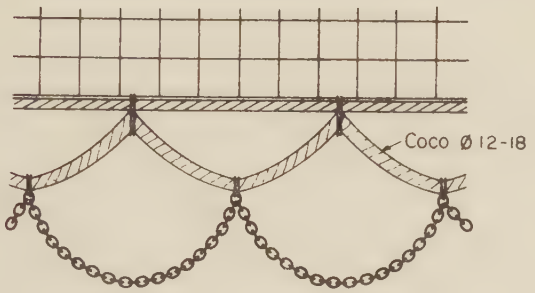


Distribution of floats and ballast Examples (2)		
50 to 180 hp boats	Type	Drwg. No
FAO, Rome, November 1977	C	28

Sinkers

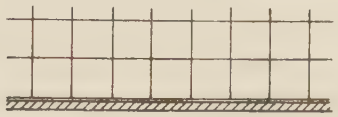




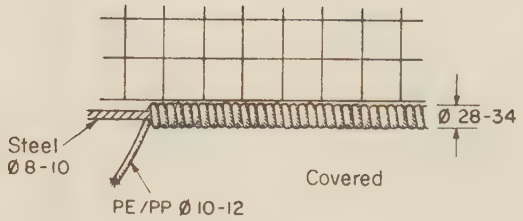


Hard or foul ground

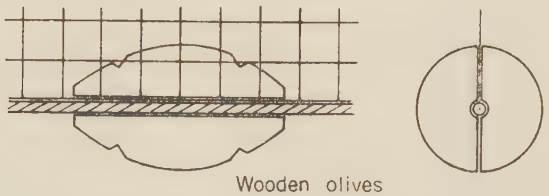
Groundrope



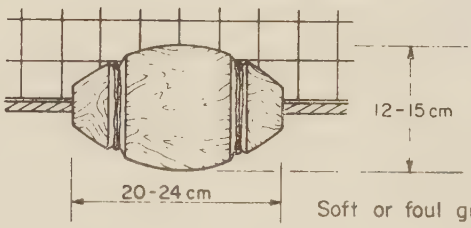
Simple



Covered

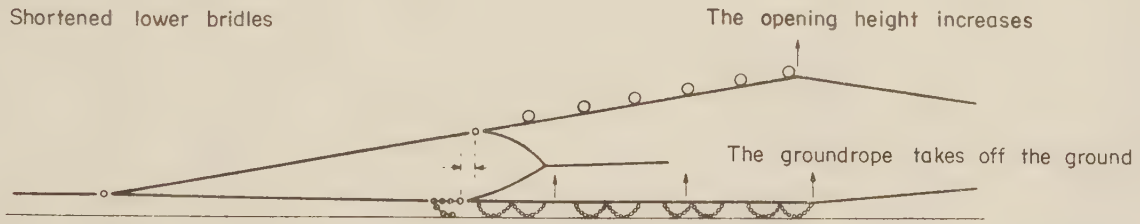


Wooden olives

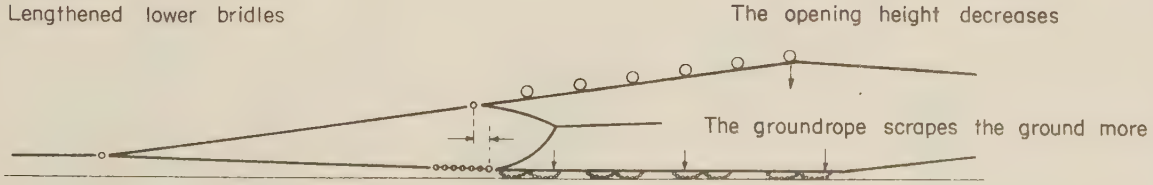


Soft or foul ground

Shortened lower bridles



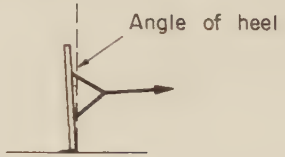
Lengthened lower bridles



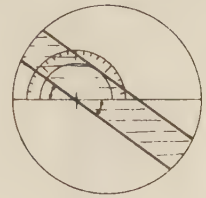
Bridles

Use of the adjustment chain

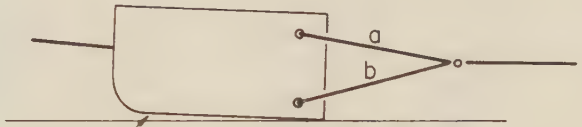
Rigging adjustment I. Groundrope, sinkers and bridles		
FAO, Rome, November 1977	Types A-B-C	Drwg. No 29



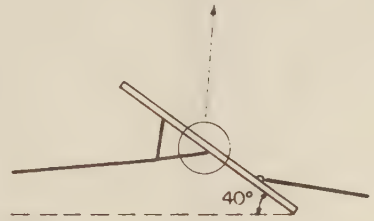
Control of angle of attack on the sole scratches



Otter boards



b - a = 2 à 5 cm



40° = optimum angle of attack of otter board

Warps and fishing rig

a = Warp length
b = Fishing rig
c = Depth

11° = optimum angle of pull at the trawl wings

Warps and depth

Rigging adjustment
II. Otter boards, warps and fishing rig

FAO, Rome, November 1977

Types A-B-C

Drwg No 30

M-41
ISBN 92-5-100582-6